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ABSTRACT

The study examines the rates and types of school bus accidents according to the age of the school bus driver. Accident rates in North Carolina for the school year 1971-72 were analyzed using three sources of data: accident reports, driver and mileage data, and questionnaires administered to a sample of school bus drivers. Data were obtained on 10,508 drivers and an annual mileage of 74,110,890 miles. Results were analyzed statistically in the areas of: accident per driver age group, accident rates per million vehicle miles, accident severity, report categories, injury accidents, injuries by passenger miles, accident type, violations, location of accident, time of accident, weather and road conditions, driver experience, the other driver, and driver characteristics. Findings did not show a simple age-related curve. Student drivers (age 16 through 20 years) had a higher accident rate than adult drivers (age 21 and over) with 16-year olds having the highest rate and 20-year olds the second highest. The final 67 pages of the document contain 44 tables, graphs, a two-page bibliography, and eight appendixes (sample traffic accident and school bus accident reports, a sample school bus driver questionnaire, and supplemental statistical information on bus drivers). (Author/BP)

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School Bus Accidents and Driver Age

Judith McMichael

University of North Carolina
Highway Safety Research Center
Chapel Hill, North Carolina

December 1974

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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ABSTRACT

This study examined the rates and types of school bus accidents according to the age of the school bus driver.

Accident rates in North Carolina for the school year 1971-72 were analyzed using three sources of data: accident reports, driver and mileage data, and questionnaires administered to a sample of school bus drivers.

Data were obtained on 10,508 drivers and an annual mileage of 74,110,890 miles. The age group mileage, number of passengers carried, and urban or rural driving exposure were related to the 1971-72 school bus drivers involved in accidents.

Research studies support North Carolina's claim of a good overall school bus safety record. This study was limited to comparisons of drivers by age group within the state. Student drivers (age 16 through 20 years) had a higher accident rate than adult drivers (age 21 and over). However, the poorer record of the younger drivers was accounted for by the 16-year-olds. When this group was removed and drivers age 17 through 20 were compared with drivers 21 and older, there were no significant differences between the two groups.

Sixteen-year-old bus drivers experienced a higher accident rate on a mileage basis than any other age group. The rate then improved significantly for 17, 18, and 19-year-old drivers. The next worst record was the 20-year-old group, then the 21 through 24-year-old drivers. The 25 through 54-year-old drivers had the safest rates, comparable with the 18-year-old drivers. The oldest age group, 55 years and over, did not perform as well, but had a better record than 16-year-old, 20-year-old, and 21 through 24-year-old drivers.

The 20 through 24-year-old drivers, who had the next worst record after 16-year-olds, are a relatively small proportion of the operating drivers, and their driving record is modified by their greater exposure to traffic accidents. As these two groups, and those 55 years and over were small, differences in accident rates could not be substantiated statistically.

Younger and older school bus drivers did not differ significantly overall in the severity of accident including the rates for injury-producing accidents.

The circumstances in which accidents occurred were investigated by age group. It was hypothesized that 16-year-old drivers, being on the whole less experienced drivers, would be likely to experience difficulty more readily in less than optimal driving conditions. The analyses of accident data appeared to support this hypothesis, since 16-year-old drivers tended to have more accidents on loose surface roads, roads with defects, and roads that were not straight and level.

Because 16-year-old drivers had the highest accident rate and because there is some evidence that this higher rate may be largely attributable to their greater inexperience, it may be worthwhile to experiment with licensing more school bus drivers at age 17 rather than age 16, provided they have had a full year of motor vehicle driving experience at that time. However, such a change should not be expected to result in as favorable accident rates as those experienced by the current 17-year-old drivers. This is because many of these drivers have had not just a year's driving experience but a successful year's experience driving a bus.

Subsequent to the 1971-72 school year studied in this report, legislation was passed which extended the learner's driving permit an additional six months. This makes it possible for beginning drivers to obtain this permit at age 15 rather than 15-1/2, which had previously been the earliest age such a permit could be obtained. If 16-year-old bus drivers were selected from among applicants who have used this permit for an entire year, and if driving an automobile transfers to driving a bus, it could be expected that the performance of such 16-year-old drivers should excel that of the 16-year-old drivers included in this study.

Although 16-year-old drivers account for only 14 percent of all school bus drivers, their elevated accident rate, which appears to be largely the result of inexperience, makes them a prime target group for efforts aimed at improving school bus safety performance. The results of this report indicate that per hour expended in working with school bus drivers, the greatest dividends will result from working with these 16-year-old drivers to expand and upgrade their training.

It should be underscored that the drivers age 17 through 19, who constitute the vast majority of the total number of school bus drivers in North Carolina, compare well with the drivers age 25 through 54. In addition, there were no age differences found in relation to the severity of the accidents incurred.

TABLE OF CONTENTS

	Page
LIST OF TABLES	iv
LIST OF FIGURES	vii
ACKNOWLEDGMENTS	viii
INTRODUCTION	1
METHOD	4
Crash Records	4
Mileage Information	5
School Bus Questionnaire	6
Student/Adult Driver Designation	7
Older Drivers	7
Statistical Method	8
RESULTS	8
Accidents per Driver Age Group	8
Accident Rates per Million Vehicle Miles	8
Accident Severity	9
Report categories	10
Injury accidents	10
Injuries by passenger miles	11
Accident Type	12
Violations	12

C

TABLE OF CONTENTS (continued)

	Page
Location of the Accident	13
Time of the Accident	13
Weather and Road Conditions	14
Driver Experience	15
The other driver	15
Driver Characteristics	16
DISCUSSION AND SUMMARY	17
CONCLUSIONS AND RECOMMENDATIONS	19
REFERENCES	66
APPENDIX A Traffic Accident Report	69
APPENDIX B School Bus Accident Report	73
APPENDIX C Annual Pupil Transportation Report (APTR)	77
APPENDIX D Questionnaire to school bus drivers . . .	79
APPENDIX E Map of counties in questionnaire sample	85
APPENDIX F Number of accidents and total number of drivers in each age group	87

TABLE OF CONTENTS (continued)

	Page
APPENDIX G Statistical explanation of Chi-square used (written by Dr. Yosef Hochberg)	89
APPENDIX H Number of fatalities and injuries in each accident bus driver age group	93

LIST OF TABLES

Table		Page
1.	Ages of the questionnaire sample of school bus drivers and their current educational status	22
2.	Number of older drivers in the 1971-72 mileage figures and the 1974 questionnaire sample	23
3.	Accident involvement for types of accident reports by driver age groups	24
4.	Yearly mileage by operating driver age groups	25
5.	Days driven annually by operating driver age groups	26
6.	Daily mileage by operating driver age groups	27
7.	Accident rates per million vehicle miles for types of accident reports by driver age groups	28
8.	Accident rates per million vehicle miles for property and injury accidents by driver age groups	[illegible]
9.	Average daily mileage for male and female drivers in the questionnaire sample of age groups	30
10.	Traffic and non-traffic accidents by accident driver age groups	31
11.	Type of report made on the accident by accident driver age groups	32
12.	Injury and property accidents by accident driver age groups	33
13.	Cost per accident by accident driver age groups	34
14.	Cost of accident damage for drivers 21 years and over by sex	35

LIST OF TABLES (continued)

Table		Page
15.	Driver injury by accident drivers 16-20 and 21 and over	36
16.	Pedestrians struck by type of vehicle by accident school bus drivers 16-20 and 21 and over	36
17.	Injury or fatal accidents and the numbers killed or injured by driver age groups	37
18.	Passengers driven daily by operating driver age groups	38
19.	Elementary school passengers driven daily by operating driver age groups	39
20.	Direction of the collision by accident driver age groups	40
21.	Accident type by accident drivers 16-20 and 21 and over	41
22.	Type of crash by driver age	42
23.	Single or multi-vehicle collision by accident driver age groups	43
24.	Vehicle condition reported for all school buses in accidents	44
25.	Vehicle condition by accident drivers 16-20 and 21 and over	44
26.	Drivers charged with violations by accident driver age groups	45
27.	Number of violations by accident drivers 16-20 and 21 and over	46
28.	Urban or rural exposure by operating driver age groups	47
29.	Highway class by accident driver age groups	48

LIST OF TABLES (continued)

Table		Page
30.	Locality by accident driver age groups	49
31.	Intersection or driveway by accident driver age groups	50
32.	Percent of crashes experienced by season of the year for accident driver age groups	51
33.	Day of week by accident drivers	52
34.	Percent of crashes experienced by time of day for accident driver age groups	53
35.	Road surface by young accident drivers	54
36.	Road defects by young accident drivers	54
37.	Road conditions by accident drivers 16-20 and 21 and over	55
38.	Weather by accident drivers 16-20 and 21 and over	55
39.	Road character by young accident drivers	56
40.	Driving experience for accident (A) and questionnaire (Q) groups by driver age	57
41.	Other driver age in accidents with school bus drivers	58
42.	Occupations of the school bus drivers over 20 in the questionnaire sample	59
43.	Occupations of the younger drivers not attending school in the questionnaire sample	60
44.	Grades of student school bus drivers in the questionnaire sample	61

LIST OF FIGURES

Figures		Page
1.	An "accident" model (from J.A. Waller, 1967).	62
2.	Accident involvement rates by driver age groups	63
3.	Accident rates per million vehicle miles for types of accident reports by driver age groups	64
4.	Accident rates per million vehicle miles for injury and property damage only accidents by driver age groups	65

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I. INTRODUCTION

Throughout the U.S.A., school buses are safer on a passenger mile basis than private passenger vehicles, and safer than most forms of public and commercial transportation (Hull, 1968). However, the fatality rate per million passenger miles, over a five year period from 1965-69, gradually increased for commercial and school buses, while the fatality rate for both automobiles and airplanes tended to decline (Siegel and Nahum, 1971). The decreasing rate of automobile fatalities may be attributed in part to improved safety devices within the car, but ensuring a safer environment within buses has lagged behind. The safety record of school transportation is a matter for continuing evaluation, as this is the major method of traveling to and from school for large numbers of children.

Most studies of school bus safety records have focused on the bus driver, because of the practice of hiring teen-age and elderly drivers despite the poor driving record of these age groups in the general population. The practice has been partly dictated by the low wages paid to drivers (in North Carolina $2.07 per hour state wages in 1971-72, although some local school boards add subsidies). Furthermore, the limited number of hours and the fact that they are split in two parts limit the attractiveness of the job.

North Carolina has a high proportion of young school bus drivers (87 percent under 21 years of age in 1971-72). Like the rest of the country, in North Carolina the driving group under 20 years has a poorer overall driving record than other age groups in the driving population (Waller, 1970). But public school officials believe that a high proportion of student drivers is desirable. They report that it enables them "to be more selective in employing bus operators, require more intensive operator training, maintain an adequate number of qualified operators, exercise close supervision over the pupil transportation system and maintain a good safety record at a reasonable cost" (North Carolina State Department of Public Instruction). Research studies support North Carolina's claim of a good school bus safety record relative to that of other states, despite the considerable difficulties of making interstate comparisons based on differing accident reporting criteria (Farmer, 1969; Hull, 1969; National Commission on Safety Education, 1967). This safety record is attributed to good driver selection, training and supervision.

Comparing the safety records of younger and older school bus drivers has been more problematical. Higher accident rates of the young

and elderly drivers in the general driving population have been advanced as an argument for employing school bus drivers between 25 and 60 years of age (Charles & Shelness, 1972). There is evidence from some states that elderly drivers, and to a lesser extent drivers under 21 years, have higher school bus accident rates; however driver exposure was not obtained (Hull, 1968).

Another study (Promisel, 1969) supports the poorer record of drivers over 63 years, but otherwise relates the age of school bus drivers to accidents in a complex fashion, with age by itself being incomplete as a predictor of accident rates. For male drivers, the 16 through 18 year group had a better record than the 18 through 21 year range. The 21-year-olds and those 63 years and over had the worst records. Performance below 21 was generally as good as that above it. Female drivers showed a general improvement from 16 through 25, with the 16-year point no worse than the 35-year point. After 25, female records were worse. However, there was no statistically significant difference between overall accident rates for male and female drivers.

A study that examined school bus driving performance in relation to age in North Carolina (Campbell, 1964) found that while students had a somewhat higher accident rate, there was not a statistically significant difference. Where accidents did occur, students were more likely to be following too closely than adult bus drivers. There were indications (although not statistically significant) that student accidents, moreso than adult, were associated with situations in which the driving task becomes more demanding, such as: (1) on curved road, (2) in winter, (3) on the homeward-bound leg of the trip (driver fatigue, boisterous students, darkness in winter days).

Campbell's study, however, compared drivers age 20 and younger with drivers age 21 and older. There was no attempt made to further analyze the younger drivers by single year intervals. Because the learning curve is changing most rapidly during these beginning years of driving, this investigation focuses more closely on the year to year changes in the drivers below age 21.

Another reason for taking a second look at North Carolina school bus drivers by age is that the Division of Motor Vehicles' driver improvement representatives, who certify the school bus drivers, are divided in their opinion as to whether students or adults make better drivers. Some prefer students, feeling that one has the pick of a wide range of capability, including the future professionals of our society. Others feel that the greater maturity of the adult driver more than outweighs the range of selection afforded by using student drivers. There appears

to be general agreement that the students on the whole are no longer so select a group as was the case several years ago. The reasons given for this are, first, that many of the best students are now involved in extra-curricular activities and thus not available for driving a bus. A second reason given is that with the increase in consolidated high schools the school principal, who makes the initial selection of school bus trainees, does not know the students as well as was once the case. Previously the principal was likely to have known the student and his family since the student was a small child. Now the selections are made on the basis of much more limited information. Therefore it was deemed advisable to take another look and a more intensive look at school bus drivers in North Carolina.

This investigation made use of a model (Waller, 1967) which illustrates the imbalance between human capabilities and the demands of a system and describes three general types of situations in which human performance fails to meet the demands of the task. The first situation involves cataclysmic human failure, such as a sudden stroke, while performing a task that is not particularly demanding. The second situation, in which failure occurs because of the overwhelming demands of the task, may be exemplified by an average driver who suddenly has a blowout on a busy highway. There is evidence, however, that a third situation may be much more common. This is a simultaneous decrease in performance and increase in task demand (see Figure 1, p. 62. It should be noted that all figures and tables appear at the end of the text). An example might be the school bus driver's attention being diverted from the road to the passenger (decrement in driver performance), thereby causing the vehicle to run off the shoulder of a narrow gravel road (increase in task demands), and to scrape a post (the "accident"). According to this model, it might be anticipated that younger drivers with less experience and thus a lower overall level of driver performance may be less able to cope with more complex driving situations, such as poor weather conditions (increased task complexity), and thus would experience a disproportionate number of their crashes under such demanding circumstances. This hypothesis will be examined in the analysis.

II. METHOD

Three sources of data were used: crash records, mileage records, and questionnaire data from school bus drivers.

Crash Records

North Carolina requires reports on all school bus crashes, whether or not they occur on a public highway, and even if the damage is slight. Crash reporting can be assumed to be fairly thorough and reliable because: (1) the school bus driver must report each accident; (2) school principals are responsible for supervising school transportation; (3) drivers are instructed to have each accident investigated by a police officer; and (4) the State Board of Education and the Division of Motor Vehicles exchange crash information to detect any discrepancies.

The report forms were obtained from two sources: (1) the Traffic Accident Report (see Appendix A), which is used for the more serious accidents where personal injury and/or $100[1] worth of property damage has occurred. The State Highway Patrol or local police investigate and file the report with the Accident Records Section of the North Carolina Division of Motor Vehicles; (2) the School Bus Accident Report (see Appendix B) which is completed by school officials for every accident. Copies are forwarded to the State Board of Education and the Division of Motor Vehicles. The Division of Motor Vehicles discards the School Bus Accident Report where it duplicates Traffic Accident Reports, and, using a standard format, transfers the information onto punch cards and computer tape.

The computer punch cards and tape were obtained for all school bus crashes from July 1, 1971 through June 30, 1972. In order to study all school bus drivers, a new record was made for the second driver in crashes which involved two school buses, which changed the format from an accident oriented to a driver oriented record.

Because crashes were to be related to mileage to obtain accident rates, 25 crashes were omitted which involved private or commercial buses. Mileage could not be obtained in these cases because the State Board of Education keeps data only on state funded and operated school transportation.

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[1] *In July 1972, the property damage criterion was raised to $200.*

This data source yielded 1971 records on school bus drivers involved in accidents in 1971-72. Of these drivers, age was available for 1888 (96 percent).

Mileage Information

Mileage was needed to calculate exposure, i.e., miles driven for each driver age group. As the state pays over 90 percent of the total annual cost of school transportation (Markham, 1966), the State Board of Education keeps information on the operation of school buses. The Annual Pupil Transportation Report (APTR, see Appendix C), compiled from the school principals' monthly reports, gave passenger and mileage information by driver age but not by name.

The report is oriented more to the number of buses than to the number of drivers. Consequently, care was taken not to double-count the same driver. But when a new driver took over on a bus, age information was often not available. Total yearly mileage was based on the total daily route mileage multiplied by the number of operating days, plus extra mileage, rather than on odometer readings.

For this study, a record was set up for each driver. The information taken from the APT Report included driver age, county, name of the school, bus number, number of operating days, total mileage for the school year, and number of elementary and high school pupils transported daily.

In addition, the schools were coded according to the grades taught. Using the Education Directory (North Carolina State Department of Public Instruction) and a map, the schools were coded according to their urban or rural locality. The cities were coded according to their population rank in the 38 cities in North Carolina with populations over 10,000 based on the 1970 census. (North Carolina State Board of Health, 1972). Data on exposure in some urban areas must be cautiously interpreted. Many city school units do not receive state transportation money because of two statutory limitations: neither state nor local boards of education are required to provide funds for transporting children who (1) live within 1-1/2 miles of the school or (2) live within the same municipality as the school (Markham, 1966).

Therefore the schools, mainly urban, who fund their own transportation do not report mileage and driver data to the State Board of Education. These include Fayetteville, Salisbury, Asheville, Statesville, Raleigh, and Rocky Mount. Charlotte and Durham operate both a local and state funded system.

The total mileage obtained for this study from the APTR forms was 74,110,890. This differs by only three percent from the 76,602,955 miles separately reported by the State Board of Education. The discrepancy is due to some errors in calculation on the APTR forms, and mileage not reported on some county forms.

The number of drivers obtained was 10,508, as substitute drivers and drivers on special mileage were included. These drivers, although not included in the 10,430 drivers funded by the State Board of Education, could have appeared in the accident reports. Ages were unknown for 105 drivers, and another 87 were described only as adult drivers, exact age unknown. Therefore, detailed age group analyses were based on 10,316 drivers, and analyses of the two age groups, "16 through 20 " and "21 and over," were based on 10,403 drivers.

School Bus Questionnaire

Existing reports supplied little information on the characteristics of school bus drivers in North Carolina beyond their ages. A questionnaire (see Appendix D) was drawn up and pilot tested to obtain more information on school bus drivers. More descriptive information was desired to provide characteristics to link with age group safety records for a later study. However, information from this questionnaire sample was used in this study, including passenger mileage, mileage by driver sex, driving experience, and educational and occupational status.

A survey of all 10,430 school bus drivers in 100 counties was not feasible. Among the 10,430 bus drivers, only 1,399 (13 percent) were adult drivers, and these were spread over 90 counties. In order to obtain a sample size large anough for statistical analysis, questionnaire responses from a large proportion of the adult bus drivers were required.

To reduce problems in the selection and distribution of questionnaires, whole counties were sampled. This procedure also provided data for age comparisons within counties. In order to obtain counties with a relatively large proportion of adult drivers, and to minimize the number of counties surveyed, only counties with more than 10 adult drivers who comprised at least 20 percent of the school bus drivers in that county were selected. In order to increase the coastal and urban representation, an exception was made for New Hanover county with 24 adults making up 19 percent of the total drivers. Although the survey was for the 1973-74 school year, selection was based on the available 1971-72 figures. This method yielded 28 counties, distributed throughout the mountain, piedmont, and coastal regions (see Appendix E).

The questionnaires were returned by all but one of the 28 sample counties. Jackson County received the forms too late for the last drivers' meeting of the school semester. An 80 percent return rate yielded 2229 questionnaires from 27 counties representing 21 percent of the total school bus drivers in the state and 63 percent of the adult drivers. The name of the school was not completed on 30 questionnaires, and the driver's age was not provided on 22 forms. Ninety percent of the drivers had regular routes, 202 (9.1 percent) were substitute drivers, and 22 (1.0 percent) did not answer this question.

Student/Adult Driver Designation

The State Board of Education uses age 21 as a convenient dividing line to designate drivers as student or adult. In the questionnaire sample of school bus drivers in 27 counties in the 1973-74 school year, after age 18 the proportion of drivers who were school students dropped considerably. As can be seen in Table 1, only 53 percent of the 19-year-olds and 18.9 percent of the 20-year-olds were still attending high school. The small number of drivers over 20 years who answered that they were attending school may have been taking classes, or they may be school employees who confused the intent of the question. These proportions may not be exactly representative of total drivers, but they do demonstrate that it cannot be assumed that the 19 and 20-year-old drivers, particularly, were all high school students and therefore subject to the same supervision as the 16, 17, and 18-year-old drivers, who are nearly all school students.

Older Drivers

There were 146 drivers 55 years and over in 1971-72. The questionnaire sample which covered 63 percent of adult drivers included 70 drivers who were at least 55 years old (see Table 2). The mileage data showed no statistical difference among the older drivers on their yearly mileage or the number of passengers they drove each day. Because the numbers in the age group were small, and the accident tape obtained from the Department of Motor Vehicles coded these drivers only as an age group 55 and over, mileage could not be related to accidents for a more detailed age analysis.

Statistical Method

The major statistical test used was the Chi-square, and results were accepted as significant at the 0.05 level. Analyses of variance have been applied to differences among group means. (A statistical explanation of the Chi-square used in testing accident rates is included in Appendix G.)

III. RESULTS

Accident per Driver Age Group

The number of accidents for each age group was matched with the total number of drivers in each age group (see Appendix F).

An accident involvement rate (i.e., the number of accidents divided by the number of drivers in each age group) was calculated for three types of accidents. "All Accidents" are all the school bus accidents. "Traffic Accidents" are the accidents occurring on a public road. This category does not include those accidents which occurred on private grounds or in driveways (approximately 11 percent of all drivers' accidents in 1971-72). "Police Report Accidents" are the more serious school bus accidents which are reported to and investigated by law enforcement officers. These constituted 70 percent of total driver accidents. As can be seen in Table 3 and Figure 2, the age groups 16 years, 20 years, and 21 through 24 years, consistently had the highest rates for the three types of accident reports.

Data are presented on these three accident types in order to demonstrate the difficulties of interstate comparisons. Different states have different criteria for reporting accidents. Any one of these types of accident reports could be used as the standard. In addition, some states have a property damage criterion whereby school bus accidents are not reported when damages are below $100.

Accident Rates per Million Vehicle Miles

The number of accidents incurred by each driver age group is not a valid method of comparison because this figure does not take mileage exposure into account. The higher involvement rate of 16-year-old,

20-year-old, and 21 through 24-year-old drivers could be attributable to their driving more miles and therefore being exposed to more accident risks.

Age group mileage was obtained from the APTR forms. Nineteen-year-old drivers had the highest mean yearly mileage (7152) and 18-year-olds the lowest (6732). An analysis of variance showed statistically significant differences between the age groups (see Table 4). Nineteen-year-old drivers drove the most number of days, followed by 18-year-olds. Twenty-year-olds drove the fewest days (see Table 5). Twenty-year-olds and 21 through 24-year-olds drove the most daily mileage, while 18-year-olds drove the least (see Table 6).

The accident rate used in this study is the number of accidents per million vehicle miles. Tables 7 and 8 display accident rates for each age group. When young drivers (age 16 through 20) were compared with older drivers (age 21 and over), the accident rate of the younger drivers was found to be significantly higher. However, when the 16-year-old drivers were eliminated from the comparison, the remaining young drivers compared favorably with the older drivers, showing no significant differences between the two groups.

Looking more closely at each age group by type of accident, the same pattern emerges for all five categories of accident. Sixteen-year-old drivers have the highest accident rates, followed by twenty-year-olds and drivers 21 through 24-years old. The differences between an age group and the average rate for all other age groups for "All Accidents" was statistically significant. The 16-year-olds had the worst rate, and the 18 and 25 through 54-year-old groups had the best rates. The 20, 21 through 24, and 55 years and over groups were too small to allow statistically significant rate differences (see Appendix G for an explanation of the statistical method).

Promisel (1969) reported that male bus drivers had poorer records from age 18 through 28. Young female drivers did well but tended to do worse with increasing age. Our data peak for the 16-year-old and 20 through 24-year-old age groupings, but could not be analyzed for sex differences. There were no consistent differences reported in the mileage estimates of male and female driver questionnaire respondents, so there may be no sex differences in miles driven (see Table 9).

Accident Severity

The data so far presented show that 16-year-olds had the worst record, and that 18 and 25 through 54-year-olds had the best. However,

the number of crashes does not take into account the severity of the accident. Therefore, crash severity and the number of injuries incurred were analyzed by accident driver age groups.

Report categories.

Non-traffic accidents (i.e., crashes occurring off public roads, in driveways, and on school grounds) were approximately 11 percent of of all crashes, and the differences between age groups were not significant (see Table 10).

There was no significant difference between the driver age groups on the basis of whether the report was from the police or the school (see Table 11).

Only 16.2 percent of the crashes of school bus drivers were injury producing, with no significant differences among age groups (see Table 12).

The amount of damage done in each crash did not differ significantly for the driver age groups (see Table 13).

Crash severity was examined according to the sex of the driver because some bus supervisors maintained that women drivers had less severe accidents. The proportion of injury or property accidents was not associated with driver sex. Looking at the amount of damage, the sex of the drivers age 16 through 20 years made no difference. However, the female drivers over 20 did do less damage than the male drivers over 20. Of the women, 89.3 percent had damages below $500, compared to 79.1 percent of men (see Table 14).

Injury accidents.

The following findings are concerned with possible differences in the number of injuries, another measure of the severity of the accident.

Table 12 shows that only 16.2 percent of the crashes were injury producing and that there were no significant differences among the driver age groups. Drivers were injured in only 1.3 percent of the cases and there was no significant difference between drivers age 16 through 20 and those age 21 and over (see Table 15). The 24 drivers injured were too few to do a full age group analysis. Driver injury was not a reliable index of driver differences, because drivers were injured in such a small proportion of the cases.

The age of the school bus driver did not appear to be a factor in the 19 cases where pedestrians were hit by a motor vehicle. The small number did not allow a full age group analysis (see Table 16). In school transportation accidents, pedestrians, usually pupils entering or leaving a school bus, are more likely to be struck by the school bus (74 percent of cases) than by another motor vehicle.

The number and type of injuries are set out in Appendix H. Injuries are coded A, B, and C in decreasing order of severity. The code is more exactly defined on the Traffic Accident Report (see Appendix A). There were no large discrepancies among driver age groups for the percentage of drivers in fatal or injury accidents or the percentage of deaths or injuries sustained (see Table 17).

Injuries by passenger miles.

The number of injuries sustained is likely to be related to the number of passenger miles of buses. The number of people that could be injured in a collision depends on the number of passengers carried. Furthermore, a greater number of passengers getting on and off the bus increases the risk of pedestrian accidents. Therefore, a measure of exposure of passengers at risk was obtained by looking at the number of passengers carried.

The bus routes are planned to keep deadhead (empty bus miles) to a minimum. The estimates from the bus driver questionnaire suggested that only 14.4 percent of daily mileage was driven with no passengers on board. Therefore, vehicle miles can be used as a rough measure to examine passenger injuries by passenger miles. Drivers age 55 and over drove the lowest average number of passengers daily (63.9), while 20-year-old and 21 through 24-year-old drivers carried the largest numbers daily (73.9 and 73.2). While there is little difference in the injury rate by driver age group, 20 through 24-year-old drivers were safely carrying more passengers daily (see Table 18). This would improve their safety record on an accident per passenger mile basis.

Whether younger or older pupil passengers make the driver's task more difficult, and thus by their behavior on the bus affect the risk of collision and injury (in the event of a collision), is a matter of opinion. The 21 and 25 through 54-year-old drivers carry the largest average daily number of elementary pupils per driver (see Table 19).

Accident Type

To maintain and improve a safety program for school bus transportation, the circumstances in which accidents occur must be studied. The following results concern the characteristics of accidents and the circumstances in which they occur, by driver age.

There were no statistically significant differences among age groups in the angle of collision (see Table 20).

Drivers 16 through 20 and 21 and over did not differ significantly overall in the type of accident, although the younger drivers were somewhat more likely to be involved in collisions involving another school bus. Most of the accident type categories were small (see Table 21).

Data (HSRC, 1974) indicate that drivers under 20 years, especially males, are overrepresented in single automobile collisions, suggesting an inexperience factor. In this study, a comparison of single and multi-vehicle collisions shows 19.1 percent of the accidents of 16-year-old drivers were single vehicle accidents compared to only 12.6 percent of 17 through 20-year-old driver accidents (see Table 22). Sixteen-year-old drivers had a higher proportion of single vehicle collisions than the other age groups. The proportion for the 17 through 20-year-old group was similar to that of the older age groups (see Table 23).

Of buses in crashes, defects were reported for only 2.5 percent, with defective brakes accounting for most (see Table 24). For 13.9 percent of the vehicles, defects were either not known or not stated. There were no appreciable differences among the driver age groups on the basis of vehicle condition (see Table 25).

Violations

Of the 1882 drivers for whom the age and type of violations were reported, the highest proportion with charges were 16-year-old drivers (61.5 percent) followed by 17-year-olds (61.2 percent). Those with the least proportion of drivers charged were the 25 through 54-year-old drivers with 48.4 percent (see Table 26).

School bus drivers had 1128 violations charged against them, with 11 drivers having two violations each. The most frequent charge made against both the 16 through 20-year-old and 21 and over drivers was "unsafe movement;" the next was "improper backing." The two groups did not differ greatly in the type of violations charged against them,

except that six percent of the violations for the 16 through 20-year-old group were for "following too closely" (see Table 27). The number of violations was too small to analyze violation type by age group.

Location of the Accident

The locality where people were doing most of their driving is associated with their exposure to risk of crash and affects the number and type of crashes experienced. Type of driving (urban vs. rural) for each driver was obtained by determining the locality of the supervising school as explained in the Methods section earlier. The 20-year-old and 21 through 24-year-old drivers were employed significantly more than the others in cities. This may provide some explanation of their higher accident rate for mileage driven, since they were exposed to more risks from traffic (see Table 28). The urban or rural areas in which drivers are employed also suggests that type of exposure accounts for the 20-year-old and 21 through 24-year-old drivers having more accidents than the other age groups on city streets (see Table 29).

The kind of locality (i.e., open country, residential, school grounds, or business) in which accidents occur showed no statistically significant differences for the age groups. However the small differences do follow the pattern of the previous table. The 20-year-olds and 21 through 24-year-olds had more accidents than other age groups in residential or industrial and business localities. Drivers 55 years and over had most accidents (53.8 percent) in open country (see Table 30).

The proportion of accidents occurring at intersections and driveways showed no statistically significant differences among the age groups. The slightly higher proportion of 20-year-old and 21 through 24-year-old drivers in accidents at intersections could be explained by the larger amount of city driving they do, and thus, the larger number of intersections they must negotiate. Older drivers, 55 years and over, had a greater proportion of crashes not at intersections, reflecting their greater amount of rural driving (see Table 31).

Time of the Accident

Twenty-seven percent of accidents occurred in winter, thirty-two percent in spring, six percent in summer (reflecting the months that the schools are closed), and thirty-five percent in fall. Campbell (1964) found a tendency (not statistically significant) for drivers younger than 21 to have more winter time accidents than drivers older than 21.

Although there are statistically significant differences among the age groups there are no clear trends readily observable (see Table 32).

While a somewhat larger proportion of drivers' accidents occur on Friday, the differences were not significant for driver age (see Table 33).

Drivers under 21 had a similar proportion of accidents on both the school-bound and home-bound trip, but drivers 21 and over had more accidents on the morning trip and fewer on the home-bound trip (see Table 34).

Weather and Road Conditions

To explore the hypothesis that younger drivers (age 16) with less driving experience had a larger proportion of accidents when the driving task became more difficult (as discussed earlier in the Waller model), accidents in difficult driving conditions were examined.

There was no significant difference overall between driver age groups and the type of road surface. However, 16-year-old drivers had a higher proportion of accidents on loose surface roads than the other age groups. Considering only the younger drivers, 16-year-old drivers had a significantly larger proportion of accidents (17.6 percent) on loose surface roads than the 17 through 20-year-old drivers (12.3 percent; see Table 35).

Another variable, road defects, was examined as an index of the difficulty of the driving task. No statistically significant difference was found, although when roads had defects (e.g., ruts or defective shoulders), 16-year-old drivers had a slightly higher proportion of accidents than the drivers 17 through 20 years (see Table 36).

There was no significant difference between drivers 16 through 20 years and 21 and over on the basis of road conditions, although the younger group did have slightly more crashes when roads were not dry than the drivers over 20 years. A breakdown by age groups did not show a significant difference for 16-year-old drivers (see Table 37).

Weather affects visibility and road surfaces and can make the driving task more difficult. The difference was not statistically significant, but again younger drivers did have slightly more accidents when weather conditions were not clear with rain, snow, clouds or fog (see Table 38).

Whether the road was straight and level, or straight and hilly, curved and level, or curved and hilly, showed no significant differences. Sixteen-year-old drivers did have a slightly higher proportion of accidents under the more difficult task of driving on roads that are not straight and level (see Table 39).

Driver Experience

Information about the amount of driving experience in years is requested on both the Traffic Accident Report and School Bus Accident Report, but neither report form stipulates whether general driving or only bus driving experience is to be indicated. Also, driving experience is coded in years, and it is possible that less than one year's experience is classified as one year.

The questionnaire to school bus drivers asked for both bus driving and general driving experience in years and months. The two types of driving experience differed, and older age groups had a higher proportion of general driving experience and a lower proportion of bus driving experience.

When the questionnaire sample is compared with the accident sample, the proportion of general driving experience is about the same (see Table 40). Ninety-nine percent of 16-year-olds in accidents had less than two years of driving experience, which corresponds with the questionnaire group not involved in accidents. This proportion is to be expected as provisional licenses are available beginning at age 16. The 17-year-old drivers in accidents with less than two years experience are not overrepresented when they are compared to the experience one would expect, based on the questionnaire group. For 18-year-olds in accidents, 26.4 percent had less than two years driving experience, which was a lower proportion than the bus driving experience of the 18-year-old questionnaire group, but higher than the general driving experience of that same group. The 19-year-old group, although they have a good overall safety record, showed a much higher proportion of inexperienced drivers (30 percent compared to 6.3 percent in the questionnaire sample with less than two years general driving experience). The other age groups did not differ.

The other driver.

Of the crash-involved drivers, 15.4 percent were involved in an accident on the school grounds (see Table 30). More may have been involved in accidents in the close vicinity, although this is not

entered on the report forms. One would expect that if a substantial number of accidents occur in or near the school grounds, there is an increased possibility that the other driver involved would also be youthful, as there would be a higher representation of young people driving to and from school at the same time as the school buses.

Table 41 shows the age of the 1603 other drivers involved in an accident with a school bus. For the 1241 whose age is known, 14.7 percent were 17 years and below, and 7.6 percent were 18 through 19 years. These are higher proportions than those generally represented in North Carolina crashes, where 8.5 percent of the drivers involved are 16 and 17 years and 11.4 percent are 18 and 19-year-olds (Waller, 1970).

Driver Characteristics

A further study is planned to link the driver characteristics obtained from the driver questionnaire sample to individual driver records. However, some characteristics shown by the questionnaire sample provided an interpretation of age group accident rates.

One reason put forward for hiring student drivers is that they are more readily available for supervision than adult drivers. However, about 40 percent of the drivers surveyed over age 20 were school employees; the next largest group was housewives (31 percent). The age group with the best safety record among the older drivers was the 25 through 54-year-old group, who had, by far, the largest proportion of people who stated their occupation as home duties (nearly 35 percent). All the other occupational groups were much smaller, except that 25 percent of the 55 years and older group were retired or unemployed (see Table 42).

Eighty-six drivers under age 21 in the questionnaire sample were not attending school. All 16-year-old drivers were students. Although the numbers were too small to calculate occupational proportions for each age, the largest occupational group was the one of individuals attending college (about 31 percent); 22 percent were school employees (see Table 43).

Looking at the grades of the student drivers in the questionnaire sample, the largest proportion had a C average; the next largest group was the B average students. Twenty-year-old drivers had the largest proportion of C grades, nearly 86 percent (see Table 44).

IV. DISCUSSION AND SUMMARY

School bus accident rates were calculated both in terms of accidents per driver age group and accidents per million vehicle miles by driver age group. The accident rates did not show a simple age-related curve clearly differentiating between student and adult drivers. Rather, both procedures for determining accident rate showed 16-year-old drivers to have the highest accident rates, followed by the 20-year-old and the 21 through 24-year-old groups. The drivers age 17 through 19 had rates that compared favorably with drivers age 25 through 54. These same relationships were found for all five categories of accidents, namely, all accidents, traffic accidents, police report accidents, property damage only accidents, and injury accidents (see Figures 3 and 4).

Comparing driver mileage information with accident information, there were no significant differences found among age groups for accident severity. Once the drivers were involved in an accident, the amount of damage did not differ by age group. However, it was the impression of some school bus driver supervisors that female drivers did less damage in accidents than male drivers. This impression proved partially correct in that 89.3 percent of the female drivers age 21 and over in accidents reported damage below $500 compared with 79.1 percent of accident-involved male drivers age 21 and over (see Table 14).

The rates on injury-producing accidents and the number of people injured showed no significant differences by age group. Drivers age 20 and age 21 through 24 carried the largest number of passengers daily, thus increasing their potential for having more passengers injured should an accident occur. Since these drivers did not experience greater numbers of passengers injured, their safety record looks somewhat better, then, when one considers the number of passengers safely carried.

No information was available on the type of injury sustained by passengers, beyond the degree of severity. Information was not available on injury caused to passengers by their impacting interior parts of the bus, but this is an important aspect of injury prevention (Snyder, 1972). Vehicle defects were reported by only 2.5 percent of accident drivers, most of these being defective brakes (see Table 24).

Twenty-year-old and 21 through 24-year-old drivers were employed significantly more than the other age groups in cities (see Table 28). This may provide some explanation for their higher accident rate per miles driven, because they are exposed to more risks from traffic. This is borne out by the fact that these age groups had a greater proportion

of their accidents on city streets (see Table 29). Although the differences were not statistically significant, this pattern held for the accidents in residential or industrial and business areas (see Table 30) and for accidents in intersections (see Table 31).

The largest proportion of accidents occurred in fall, then spring, then winter, but there were no clear directions of difference among the age groups (see Table 32). A slightly higher proportion of accidents occurred on Fridays, but there were no age group differences (see Table 33). Drivers 16 through 20 years had a similar proportion of accidents on the school-bound and home-bound trips, but the drivers over 20 had more accidents in the morning and fewer on the home-bound trip (see Table 34).

Accidents in more difficult driving conditions were examined to explore the hypothesis that inexperienced drivers are likely to have more accidents when the driving task becomes more demanding. Sixteen-year-old operating drivers had, of course, the largest proportion with less than two years driving experience, 99 percent (see Table 40). Focusing on the group with the least driving experience, 16-year-olds were more likely to be at fault in accidents, and were more likely to have accidents under adverse conditions.

Sixteen-year-old drivers had the highest proportion of violations, 61.5 percent, followed by 17-year-old drivers with 61.2 percent. The 25 through 54-year-old drivers, who also have a good safety record, had the smallest proportion of accident-driver charges (48.4 percent; see Table 26). The numbers for each violation type were too small to warrant an age group analysis.

Younger drivers in the general driving population have been shown to have the largest proportion of single vehicle accidents. Such accidents tend to be more severe than multi-vehicle accidents. Although the amount of damage did not differ significantly for the age groups, 16-year-old accident drivers had a higher rate of single-vehicle accidents (19.1 percent compared to 12.6 percent of 17 through 20-year-old drivers; see Table 22). Sixteen-year-old drivers had a higher proportion of accidents occurring on loose surface roads than the other younger drivers (see Table 35), and a slightly but not significantly higher proportion on roads with defects (see Table 36). They had a slightly but not significantly higher proportion of accidents on roads that were not straight and level (see Table 39). Drivers 16 through 20 years had slightly but not significantly more crashes than drivers over 20 on roads that were not dry (see Table 37) and in bad weather (see Table 38).

Questionnaire data on the characteristics of the drivers employed provide some probable hypotheses concerning safety records. The 25 through 54-year-old group which had a good safety record includes a large proportion of housewives and school employees. However, the 21 through 24-year-old group with a poorer safety record also includes a large proportion of school employees (see Table 42). The largest proportion of 20-year-old drivers, who as a group also have a poorer record, were no longer school students (see Table 1). Those still in school were not high academic achievers (see Table 44), and those who had left school had a variety of occupations, the largest group in the questionnaire sample being college students (see Table 43).

V. CONCLUSIONS AND RECOMMENDATIONS

The results indicate that 16-year-old bus drivers experienced a higher accident rate than other age groups. Ages 17 through 19 years compared reasonably favorably with older drivers aged 25 through 54 years. Bus drivers aged 20 through 24 years and 55 years and over had higher accident rates on a mileage basis than the 17 through 19-year-old drivers, but these older groups were small and the differences could not be substantiated statistically.

There were not large differences between the age groups on the severity of accidents. Differences in the location of the accidents were explained by the higher proportion of 20-year-old and 21 through 24-year-old drivers who are employed in urban areas, and this also provides some explanation for their elevated accident rate as they are exposed to more traffic risk.

There was evidence that the most inexperienced group, the 16-year-old drivers, had a higher proportion of accidents in circumstances where the driving task was more demanding such as on loose surface roads, and slightly but not significantly more accidents on roads with defects and on roads that were not straight and level. Drivers under 21 years had slightly more crashes in bad weather and on roads that were not dry.

Sixteen-year-old drivers also had the highest proportion of violations, and the highest proportion of single-vehicle collisions.

In view of these results, it may be worthwhile to experiment with licensing more school bus drivers at age 17 years rather than age 16, provided they have had a full year of driving experience at that time. Such a procedure could not be expected to result in a reduction in acci-

dent rates among first year drivers comparable to the current 17 year-old drivers, since many of the drivers in the latter category have had not just a year's driving experience, but a year's experience driving a school bus.

Furthermore, there was a selection factor operating, since a bus driver can lose his certification if he is convicted of any of the following, whether they occur while he is driving a bus or otherwise:

1. Any conviction that would bring suspension or revocation of driving privileges.
2. Passing a stopped school bus.
3. Two moving violations in a 12 month period.
4. Hit and run involving property damage.
5. Speeding in excess of 15 mph above the posted speed limit.
6. Any moving violation in connection with an accident.

In addition, a driver can lose his certification while driving a school bus, if he is convicted of failure to stop at a railroad crossing, speeding, or failure to stop at a stop sign.

Thus the 17-year-old drivers who drove a bus when they were 16 survived the first year without any of the above infractions.

Subsequent to the 1971-72 school year studied in this report, legislation was passed extending the limited driver's permit to 15-year-olds. Previously, the earliest such a permit could be obtained was age 15-1/2. The age for licensing remains 16. The extension of this permit for an additional six months provides beginning drivers with the opportunity for additional practice before becoming eligible for licensing. If young people are actually taking advantage of this option by securing the permit earlier and gaining driving practice during this period, one should expect to have more experienced 16-year-old applicants for school bus certification. Such applicants should do better if the experience in an automobile transfers to the operation of a bus. It may be that 16-year-old school bus drivers could be selected from those applicants who have used this new permit option and have had driving experience since the age of 15.

While an earlier study of North Carolina school bus drivers showed no significant differences between the drivers under age 21 and those age 21 and older, this study was undertaken because there was some feeling that circumstances had changed in the interim and that schools were no longer likely to be able to get such good student drivers. This analysis showed that there was a significant difference between drivers age 16 through 20 and those age 21 and older, with the younger drivers

having a higher accident rate. However, it was further found that it was the 16-year-old drivers accounting for this high rate. There were no significant differences between the accident rates of drivers age 17 through 20 and those age 21 and older. Because further analyses indicated that the poor performance of the 16-year-old drivers is probably attributable to their inexperience, it is recommended that increased attention be given to the selection and training of these beginning drivers. It should be underscored that the drivers age 17 through 19, who constitute the vast majority of the total number of school bus drivers in North Carolina, compare well with the drivers age 25 through 54. In addition, there were no age differences found in relation to the severity of accidents incurred.

Table 1. Ages of the questionnaire sample of school bus drivers and their current educational status (row percentage in parentheses).

Age	At School	At College	Left School	Not Known	Total
	N (%)	N (%)	N (%)	N (%)	
16	249 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	249
17	624 (99.2)	1 (0.2)	4 (0.6)	0 (0.0)	629
18	326 (94.2)	7 (2.0)	13 (3.8)	0 (0.0)	346
19	35 (53.0)	11 (16.7)	20 (30.3)	0 (0.0)	66
20	7 (18.9)	9 (24.3)	21 (56.8)	0 (0.0)	37
21-24	1 (1.2)	9 (10.6)	74 (87.1)	1 (1.2)	85
25-54	3 (0.4)	12 (1.7)	700 (96.6)	10 (1.4)	725
55 & over	3 (4.3)	0 (0.0)	67 (95.7)	0 (0.0)	70
Not known	5 (22.7)	1 (4.5)	15 (68.2)	1 (4.5)	22
All drivers	1253 (56.2)	50 (2.2)	914 (41.0)	12 (0.5)	2229

Table 2. Number of older drivers in the 1971-72 mileage figures and 1974 questionnaire sample (column percentage in parentheses).

Age	Number	
	1971-72 Mileage	1974 Sample
	N (%)	N (%)
55-59	54 (37.0)	29 (41.4)
60-64	53 (36.3)	21 (30.0)
65-69	32 (21.9)	16 (22.9)
70 & over	7 (4.8)	4 (5.7)
All older drivers	146	70

Table 3. Accident involvement for types of accident reports (the number of accident drivers divided by the number of operating drivers in each age group).

Age	All Accidents	Traffic Accidents	Police Report Accidents
16	0.305	0.270	0.205
17	0.182	0.162	0.128
18	0.128	0.115	0.096
19	0.171	0.154	0.123
20	0.286	0.231	0.209
21-24	0.262	0.248	0.172
25-54	0.131	0.119	0.084
55 and over	0.178	0.151	0.110
All drivers	0.183	0.163	0.128
16-20	0.187	0.167	0.132
21 and over	0.142	0.128	0.091
All drivers	0.182	0.162	0.127

Table 4. Yearly mileage by operating driver age groups.

Age	Number of Drivers	Total Mileage	Mean Mileage
16	1,482	10,068,037	6794
17	4,436	29,950,399	6752
18	2,584	17,394,984	6732
19	387	2,767,856	7152
20	90	617,924	6866
21-24	145	1,014,464	6996
25-54	955	6,776,624	7096
55 and over	146	990,682	6785
All drivers	10,225	69,580,960	6805

$F_{7,\ 10217} = 2.58,\ .05 > P > .01$

Table 5. Days driven annually by operating driver age groups.

Age	Number of Drivers	Total Days	Mean Days
16	1,483	257,869	173.9
17	4,437	772,649	174.1
18	2,580	452,201	175.3
19	388	68,505	176.6
20	90	15,331	170.3
21-24	145	24,324	168.0
25-54	955	165,301	173.1
55 and over	146	25,246	173.0
All drivers	10,224	1,781,426	174.2

$F_{7, 10216} = 3.43, P < .01$

Table 6. Daily mileage by operating driver age groups.

Age	Number of Drivers	Total Daily Mileage	Mean Daily Mileage
16	1,482	58,220	39.2
17	4,432	172,755	39.0
18	2,579	99,413	38.5
19	387	15,663	40.5
20	90	3,759	41.8
21-24	145	6,066	41.8
25-54	950	39,287	41.3
55 and over	146	5,679	39.0
All drivers	10,211	400,842	39.3

$F_{7, 10203} = 3.78, P < .01$

Table 7. Accident rates per million vehicle miles for types of accident reports by driver age groups.

Age	All Accidents	Traffic Accidents	Police Report Accidents
16	45.19	40.13	30.39
17	27.25	24.24	19.20
18	19.20	17.25	14.43
19	24.21	21.68	17.34
20	42.10	33.98	30.75
21-24	37.46	35.49	24.64
25-54	18.59	16.82	11.95
55 and over	26.24	22.10	16.15
All drivers	27.13	24.19	18.99

16-20 (student)	27.93
21 and over (adult)	21.64
All drivers	27.13

17-20	24.50
21 and over	21.64
All drivers age 17 and over	24.08

Table 8. Accident rates per million vehicle miles for property and injury accidents by driver age groups.

Age	Property Accidents	Injury Accidents
16	37.94	7.25
17	23.14	4.12
18	15.23	3.96
19	20.59	3.61
20	35.60	6.47
21-24	33.52	3.94
25-54	15.94	2.66
55 and over	22.21	4.04
All drivers	22.75	4.38

Table 9. Average daily mileage for male and female drivers in the questionnaire sample by age groups.

Age	Means		Number of Drivers
	Male	Female	
16	41.9	41.4	175
17	44.5	46.5	526
18	46.4	42.9	298
19	45.6	53.1	51
20	36.4	47.8	31
21-24	47.0	41.7	70
25-54	40.5	42.3	670
55 and over	37.1	44.2	65

Table 10. Traffic and non-traffic accidents by accident driver age groups (row percentage in parentheses).

Age	Traffic Accidents		Non-traffic Accidents		Total
	N	%	N	%	
16	404	(88.8)	51	(11.2)	455
17	726	(89.0)	90	(11.0)	816
18	300	(89.8)	34	(10.2)	334
19	60	(89.6)	7	(10.4)	67
20	21	(80.8)	5	(19.2)	26
21-24	36	(94.7)	2	(5.3)	38
25-54	114	(90.5)	12	(9.5)	126
55 and over	22	(84.6)	4	(15.4)	26
All drivers	1683	(89.1)	205	(10.9)	1888

$\chi^2 = 4.15$, 7 df, $p = 0.76$. N.S.[1]

[1]*Not Significant*

Table 11. Type of report made on the accident by accident driver age groups (row percentage in parentheses).

Age	Police Report		School Report		Total
	N	(%)	N	(%)	
16	306	(67.3)	149	(32.7)	455
17	575	(70.5)	241	(29.5)	816
18	251	(75.1)	83	(24.9)	334
19	48	(71.6)	19	(28.4)	67
20	19	(73.1)	7	(26.9)	26
21-24	25	(65.8)	13	(34.2)	38
25-54	81	(64.3)	45	(35.7)	126
55 and over	16	(61.5)	10	(38.5)	26
All drivers	1321	(70.0)	567	(30.0)	1888

$\chi^2 = 9.30$, 7 df, $p = 0.23$, N.S.[1]

[1]*Not Significant*

Table 12. Injury and property accidents by accident driver age groups (row percentage in parentheses).

Age	Injury or Fatal Accidents		Property Damage Only		Total
	N	(%)	N	(%)	
16	73	(16.0)	382	(84.0)	455
17	123	(15.1)	693	(84.9)	816
18	69	(20.7)	265	(79.3)	334
19	10	(14.9)	57	(85.1)	67
20	4	(15.4)	22	(84.6)	26
21-24	4	(10.5)	34	(89.5)	38
25-54	18	(14.3)	108	(85.7)	126
55 and over	4	(15.4)	22	(84.6)	26
All drivers	305	(16.2)	1583	(83.8)	1888

$\chi^2 = 7.02$, 7 df, $p = 0.42$, N.S.[1]

[1]*Not Significant*

Table 13. Cost per accident by accident driver age groups (row percentage in parentheses).

Age	Under $100	$100-$499	$500-$999	Over $1000	Total
	N %	N %	N %	N %	
16	130 (30.4)	215 (50.2)	51 (11.9)	32 (7.5)	428
17	184 (24.5)	401 (53.5)	113 (15.1)	52 (6.9)	750
18	79 (25.2)	168 (53.7)	48 (15.3)	18 (5.8)	313
19	16 (25.0)	36 (56.3)	7 (10.9)	5 (7.8)	64
20	6 (25.0)	14 (58.3)	3 (12.5)	1 (4.2)	24
21-24	10 (27.8)	20 (55.6)	5 (13.9)	1 (2.8)	36
25-54	41 (34.7)	60 (50.8)	11 (9.3)	6 (5.1)	118
55 and over	7 (28.0)	13 (52.0)	3 (12.0)	2 (8.0)	25
All drivers	473 (26.9)	927 (52.7)	241 (13.7)	117 (6.7)	1758

$\chi^2 = 14.99$, 21 df, $p = 0.82$, N.S.[1]

[1]Not Significant

Table 14. Cost of accident damage for drivers 21 years and over by sex (column percentage in parentheses).

	Male		Female		Adult drivers	
	N	(%)	N	(%)	N	(%)
Under $100	20	(23.3)	38	(40.9)	58	(32.4)
$100-$499	48	(55.8)	45	(48.4)	93	(52.0)
$500-$999	10	(11.6)	9	(9.7)	19	(10.6)
Over $1000	8	(9.3)	1	(1.1)	9	(5.0)
Total	86		93		179	

$\chi^2 = 10.92$, 3 df, $p = 0.01$

Table 15. Driver injury by accident drivers 16-20 and 21 and over (column percentage in parentheses).

	16-20 Years	21 and Over	Total
Driver injured	19 (1.1)	5 (2.6)	24 (1.3)
Driver not injured	1679 (98.9)	185 (97.4)	1864 (98.7)
Total	1864	24	1888

$x^2 = 2.03$, 1 df, $p = 0.15$, N.S.[1]

Table 16. Pedestrians struck by type of vehicle by accident school bus drivers 16-20 and 21 and over (column percentage in parentheses).

	16-20 Years	21 and Over	All Drivers
No Pedestrian	1680 (98.9)	189 (99.5)	1869 (99.0)
Pedestrian:			
Hit by School Bus	13 (0.8)	1 (0.5)	14 (0.7)
Hit by Other Vehicle	5 (0.3)	0 (0.0)	5 (0.3)
Total	1698	190	1888

$x^2 = 0.69$, 2 df, $p = 0.71$, N.S.[1]

[1]*Not Significant*

Table 17. Injury or fatal accidents and the numbers killed or injured by driver age groups (column percentage in parentheses).

Age	Drivers in Fatal or Injury Accidents		Number of Injuries	
	N	(%)	N	(%)
16	73	(23.9)	119	(25.2)
17	123	(40.3)	186	(39.4)
18	69	(22.6)	89	(18.9)
19	10	(3.3)	10	(2.1)
20	4	(1.3)	9	(1.9)
21-24	4	(1.3)	8	(1.7)
25-54	18	(5.9)	43	(9.1)
55 and over	4	(1.3)	8	(1.7)
Total	305		472	

Table 18. Passengers driven daily by operating driver age groups.

Age	Number of Drivers	Total Passenger Daily	Mean Passengers Daily
16	1,479	99,124	67.0
17	4,417	296,286	67.0
18	2,578	170,481	66.1
19	387	25,334	65.5
20	89	6,578	73.9
21-24	142	10,398	73.2
25-54	956	66,910	69.9
55 and over	145	9,265	63.9
All drivers	10,193	684,376	67.1

$F_{7, 10185} = 3.27; p < .01$

Table 19. Elementary school passengers driven daily by operating driver age groups.

Age	Number of Drivers	Total Passengers	Mean Passengers
16	1361	63,680	50.5
17	3987	203,331	51.0
18	2363	116,619	49.3
19	348	17,820	51.2
20	84	5,045	60.1
21-24	138	8,805	63.8
25-54	934	59,033	63.2
55 and over	142	7,961	56.1
All drivers	9357	487,294	52.1

$F_{7, 9349} = 30.05$; $P < .01$

Table 20. Direction of the collision by accident driver age groups (row percentage in parentheses).

Age	Head-on	Rear-end	Angle: Broadside	Side-swipe (same)	Side-swipe (opposite)	No Collision	Total
16	6 (1.3)	126 (27.7)	110 (24.2)	62 (13.6)	61 (13.4)	90 (19.8)	455
17	12 (1.5)	250 (30.6)	203 (24.9)	129 (15.8)	106 (13.0)	116 (14.2)	816
18	6 (1.8)	116 (34.7)	76 (22.8)	46 (13.8)	45 (13.5)	45 (13.5)	334
19	2 (3.0)	26 (38.8)	14 (20.9)	13 (19.4)	6 (9.0)	6 (9.0)	67
20	0 (0)	8 (30.8)	13 (50.0)	1 (3.8)	2 (7.7)	2 (7.7)	26
21-24	0 (0)	6 (15.8)	13 (34.2)	7 (18.4)	8 (21.1)	4 (10.5)	38
25-54	1 (0.8)	34 (27.0)	31 (24.6)	22 (17.5)	21 (16.7)	17 (13.5)	126
55 and over	0 (0)	6 (23.1)	6 (23.1)	3 (11.5)	6 (23.1)	5 (19.2)	26
All drivers	27 (1.4)	572 (30.3)	466 (24.7)	283 (15.0)	255 (13.5)	285 (15.1)	1888

$x^2 = 43.34$, 35 df, $p = 0.15$, N.S.[1]

[1]*Not Significant*

Table 21. Accident type by accident drivers 16-20 and 21 and over (column percentage in parentheses).

Type	16-20 Years		21 and Over		All Drivers	
	N	(%)	N	(%)	N	(%)
Other motor vehicle	1105	(65.1)	129	(67.9)	1234	(65.4)
Parked vehicle	197	(11.6)	30	(15.8)	227	(12.0)
Ran off road or overturned	163	(9.6)	18	(9.5)	181	(9.6)
School bus	136	(8.0)	5	(2.6)	141	(7.5)
Other object	49	(2.9)	3	(1.6)	52	(2.8)
Pedestrian	17	(1.0)	1	(0.5)	18	(1.0)
Other non-collision	31	(1.8)	4	(2.1)	35	(1.9)
Total	1698		190		1888	

$x^2 = 10.85$, 6 df, $p = 0.09$, N.S.[1]

[1]Not Significant

Table 22. Type of crash by driver age (column percentage in parentheses).

Type	16 Years	17-20 Years	All Younger Drivers
	N (%)	N (%)	N (%)
Single-vehicle crash	87 (19.1)	156 (12.6)	243 (14.3)
Multi-vehicle crash	368 (80.9)	1087 (87.4)	1455 (85.7)
Total	455	1243	1698

$\chi^2 = 11.19$, 1 df, $p = < .001$

Table 23. Single or multi-vehicle collision by accident driver age groups (row percentage in parentheses).

Age	Multi-vehicle crash		Single-vehicle crash		Total
	N	(%)	N	(%)	N (%)
16	368	(80.9)	87	(19.1)	455
17	711	(87.1)	105	(12.9)	816
18	291	(87.1)	43	(12.9)	334
19	61	(91.0)	6	(9.0)	67
20	24	(92.3)	2	(7.7)	26
21-24	34	(89.5)	4	(10.5)	38
25-54	109	(86.5)	17	(13.5)	126
55 and over	22	(84.6)	4	(15.4)	26
All drivers	1620	(85.8)	268	(14.2)	1888

$\chi^2 = 13.64$, 7 df, $p = 0.058$, N.S.[1]

[1]Not Significant

Table 24. Vehicle condition reported for all school buses in accidents.

	Total Vehicles
	N (%)
Defective brakes	31 (1.6)
Other defects	19 (0.9)
Not known or not stated	273 (13.9)
No defects	1648 (83.6)
Total	1971

Table 25. Vehicle condition by accident drivers 16-20 and 21 and over (column percentage in parentheses).

Vehicle Condition	16-20 Years	21 and Over	All School Buses
Defects	41 (2.4)	4 (2.1)	45 (2.4)
Not stated or not known	218 (12.8)	29 (15.3)	247 (13.1)
No defects	1439 (84.7)	157 (82.6)	1596 (84.5)
Total	1698	190	1888

$x^2 = 0.93$, 2 df, $p = 0.62$

Table 26. Drivers charged with violations by accident driver age groups (row percentage in parentheses).

Age	Violation Charge		No Charge		Total
	N	(%)	N	(%)	
16	279	(61.5)	175	(38.5)	454
17	497	(61.2)	315	(38.8)	812
18	195	(58.4)	139	(41.6)	334
19	36	(53.7)	31	(46.3)	67
20	13	(52.0)	12	(48.0)	25
21-24	21	(55.3)	17	(44.7)	38
25-54	61	(48.4)	65	(51.6)	126
55 and over	15	(57.7)	11	(42.3)	26
All drivers	1117	(59.4)	765	(40.6)	1882

Table 27. Number of violations by accident drivers 16-20 and 21 and over (column percentage in parentheses).

Violation	16-20 Years		21 and Over		All Violations	
	N	(%)	N	(%)	N	(%)
Unsafe movement	272	(26.40)	30	(30.61)	302	(26.8)
Improper backing	183	(17.77)	21	(21.43)	204	(18.1)
Other violations	167	(16.21)	18	(18.37)	185	(16.4)
Failed to yield	118	(11.46)	12	(12.24)	130	(11.5)
Speeding	107	(10.39)	11	(11.22)	118	(10.4)
Following too close	65	(6.31)	0	(0)	65	(5.8)
Driving on wrong side	60	(5.83)	5	(5.10)	65	(5.8)
Improper turn	58	(5.63)	1	(1.02)	59	(5.2)
Total	1030		98		1128	

$x^2 = 16.39$, 8 df, $p = 0.03$

Table 28. Urban or rural exposure by operating driver age groups (row percentage in parentheses).

Age	City		Town & Rural		Total
	N	(%)	N	(%)	
16	204	(13.7)	1280	(86.3)	1,484
17	658	(14.8)	3777	(85.2)	4,435
18	341	(13.2)	2240	(86.8)	2,581
19	70	(18.0)	318	(82.0)	388
20	22	(24.7)	67	(75.3)	89
21-24	44	(30.3)	101	(69.7)	145
25-54	130	(13.7)	818	(86.3)	948
55 and over	14	(9.8)	129	(90.2)	143
All Drivers	1483	(14.5)	8730	(85.5)	10,213

$\chi^2 = 48.29$, 7 df, $p = 0.00$

Table 29. Highway class by accident driver age groups (row percentage in parentheses).

Age	City Street	Rural Road	Highway	Non-traffic	Total
	N (%)	N (%)	N (%)	N (%)	
16	183 (40.2)	173 (38.0)	48 (10.5)	51 (11.2)	455
17	325 (39.8)	284 (34.8)	117 (14.3)	90 (11.0)	816
18	127 (38.0)	119 (35.6)	54 (16.2)	34 (10.2)	334
19	28 (41.8)	22 (32.8)	10 (14.9)	7 (10.4)	67
20	17 (65.4)	2 (7.7)	2 (7.7)	5 (19.2)	26
21-24	25 (68.8)	10 (26.3)	1 (2.6)	2 (5.3)	38
25-54	63 (50.0)	37 (29.4)	14 (11.1)	12 (9.5)	126
55 and over	5 (19.2)	15 (57.7)	2 (7.7)	4 (15.4)	26
All drivers	773 (40.9)	662 (35.1)	248 (13.1)	205 (10.9)	1888

$\chi^2 = 42.85$, 21 df, $p = 0.003$

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Table 30. Locality by accident driver age groups (row percentage in parentheses).

Age	Open Country	Residential	School Grounds	Industrial or Business	Total
	N (%)	N (%)	N (%)	N (%)	
16	168 (37.8)	136 (30.6)	76 (17.1)	64 (14.4)	444
17	322 (40.9)	250 (31.7)	122 (15.5)	94 (11.9)	788
18	137 (42.9)	103 (32.3)	40 (12.5)	39 (12.2)	319
19	22 (34.9)	24 (38.1)	10 (15.9)	7 (11.1)	63
20	4 (16.0)	10 (40.0)	6 (24.0)	5 (20.0)	25
21-24	9 (25.0)	16 (44.4)	3 (8.3)	8 (22.2)	36
25-54	42 (35.0)	39 (32.5)	20 (16.7)	19 (15.8)	120
55 and over	14 (53.8)	6 (23.1)	4 (15.4)	2 (7.7)	26
All drivers	718 (39.4)	584 (32.1)	281 (15.4)	238 (13.1)	1821

$\chi^2 = 24.57$, 21 df, $p = 0.26$, N.S.[1]

[1]*Not Significant*

Table 31. Intersection or driveway by accident driver age groups (row percentages in parentheses).

Age	Intersection		Driveway		Not at Intersection		Total
	N	(%)	N	(%)	N	(%)	
16	173	(38.0)	75	(16.5)	207	(45.5)	455
17	318	(39.0)	151	(18.5)	347	(42.5)	816
18	128	(38.3)	60	(18.0)	146	(43.7)	334
19	26	(38.8)	10	(14.9)	31	(46.3)	67
20	16	(61.5)	4	(15.4)	6	(23.1)	26
21-24	21	(55.3)	4	(10.5)	13	(34.2)	38
25-54	47	(37.3)	23	(18.3)	56	(44.4)	126
55 and over	7	(26.9)	6	(23.1)	13	(50.0)	26
All drivers	736	(39.0)	333	(17.6)	819	(43.3)	1888

$\chi^2 = 14.05$, 14 df, $p = 0.44$, N.S.[1]

[1]Not Significant

Table 32. Percent of crashes experienced by season by the year for accident driver age groups (row percentage in parentheses).

Age	Autumn (Sept.-Nov.)		Winter (Dec.-Feb.)		Spring (March-May)		Summer (June-Aug.)		Total
	N	(%)	N	(%)	N	(%)	N	(%)	
16	185	(40.7)	103	(22.6)	142	(31.2)	25	(5.5)	455
17	289	(35.4)	240	(29.4)	240	(29.4)	47	(5.8)	816
18	100	(29.9)	85	(25.4)	135	(40.4)	14	(4.2)	334
19	20	(29.9)	24	(35.8)	21	(31.3)	2	(3.0)	67
20	7	(26.9)	9	(34.6)	8	(30.8)	2	(7.7)	26
21-24	15	(39.5)	10	(26.3)	11	(28.9)	2	(5.3)	38
25-54	42	(33.3)	37	(29.4)	39	(31.0)	8	(6.3)	126
55 and over	4	(15.4)	9	(34.6)	9	(34.6)	4	(15.4)	26
All drivers	662	(35.1)	517	(27.4)	605	(32.0)	104	(5.5)	1888

$\chi^2 = 35.48$, 21 df, $p = 0.03$

Table 33. Day of week by accident drivers (column percentage in parentheses).

	16-20 Years		21 Years and Over		All Drivers
	N	(%)	N	(%)	(%)
Monday	296	(17.5)	36	(19.1)	332 (17.7)
Tuesday	338	(20.0)	36	(19.1)	374 (19.9)
Wednesday	349	(20.7)	40	(21.3)	389 (20.7)
Thursday	326	(19.3)	35	(18.6)	361 (19.2)
Friday	381	(22.5)	41	(21.8)	422 (22.5)
Total	1690		188		1878

$\chi^2 = 0.43$, 4 df, $p = 0.98$, N.S.[1]

[1]*Not Significant*

Table 34. Percent of crashes experienced by time of day for accident driver age groups.

Age	Early Morning 12 M-7 am	School Pickup 7-10 am	Midday 10 am to 3 pm	School Return 3-6 pm	Evening 6 pm-12M	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	
16	11 (2.4)	170 (41.8)	48 (10.5)	202 (44.4)	4 (0.9)	455
17	11 (1.3)	355 (43.5)	97 (11.9)	339 (41.5)	14 (1.7)	816
18	7 (2.1)	132 (39.5)	33 (9.9)	156 (46.7)	6 (1.8)	334
19	0 (0.0)	33 (49.3)	12 (17.9)	22 (32.8)	0 (0.0)	67
20	0 (0.0)	10 (38.5)	7 (26.9)	8 (30.8)	1 (3.8)	26
21-24	1 (2.6)	21 (55.3)	7 (18.4)	9 (23.7)	0 (0.0)	38
25-54	1 (0.8)	59 (47.2)	25 (20.0)	38 (30.4)	2 (1.6)	125
55 and over	0 (0.0)	13 (50.0)	4 (15.4)	9 (34.6)	0 (0.0)	26
All drivers	31 (1.6)	813 (43.1)	233 (12.3)	783 (41.5)	27 (1.4)	1887

$\chi^2 = 42.29$, 28 df, $p = 0.04$

Table 35. Road surface by young accident drivers (column percentage in parentheses).

Type	16 Years		17-20 Years		Young Drivers	
	N	(%)	N	(%)	N	(%)
Hard surface	361	(82.4)	1038	(87.7)	1399	(86.3)
Loose surface	77	(17.6)	146	(12.3)	223	(13.7)
Total	438		1184		1622	

$\chi^2 = 6.99$, 1 df, $p = 0.008$

Table 36. Road defects by young accident drivers (column percentage in parentheses).

Type	16 Years		17-20 Years		Young Drivers	
	N	(%)	N	(%)	N	(%)
Road defects	41	(10.0)	90	(8.0)	131	(8.5)
No defects	369	(90.0)	1041	(92.0)	1410	(91.5)
N	410		1131		1541	

$\chi^2 = 1.36$, 1 df, $p = 0.24$, N.S.[1]

[1]*Not Significant*

Table 37. Road conditions by accident drivers 16-20 and 21 and over (column percentage in parentheses).

Type	16-20 Years		21 and Over		All Drivers	
	N	(%)	N	(%)	N	(%)
Dry road	1232	(76.3)	144	(81.8)	1376	(76.9)
Wet, muddy, icy snowy, oily, etc.	382	(23.7)	32	(18.2)	414	(23.1)
Total	1614		176		1790	

$\chi^2 = 2.38$, 1 df, $p = 0.12$, N.S.[1]

Table 38. Weather by accident drivers 16-20 and 21 and over (column percentage in parentheses).

Type	16-20 Years		21 and Over		All Drivers	
	N	(%)	N	(%)	N	(%)
Clear	1044	(63.7)	125	(69.1)	1169	(64.2)
Not clear	595	(36.3)	56	(30.9)	651	(35.8)
Total	1639		181		1820	

$\chi^2 = 1.81$, 1 df, $p = 0.17$, N.S.[1]

[1]*Not Significant*

Table 39. Road character by young accident drivers (column percentage in parentheses).

Type	16 Years		17-20 Years		Young Drivers	
	N	(%)	N	(%)	N	(%)
Straight and level	234	(54.5)	691	(59.4)	925	(58.1)
Not straight and level	195	(45.5)	473	(40.6)	668	(41.9)
Total	429		1164		1593	

$\chi^2 = 2.79$, 1 df, $p = 0.59$, N.S.[1]

[1] Not Significant

Table 40. Driving experience for accident (A) and questionnaire (Q) groups by driver age.

Age	Group and Type of Experience	Less Than Two Years (%)	Two Years (%)	Three More Years (%)	Number of Drivers
16	A-Accident group	99.0	0.0	1.0	418
	Q-General experience	98.7	0.4	0.2	246
	Q-Bus driving experience	99.5	0.0	0.2	230
17	A-Accident group	86.3	13.2	0.5	781
	Q-General experience	88.8	10.2	0.6	617
	Q-Bus driving experience	96.7	3.3	0.0	607
18	A-Accident group	26.4	70.4	3.2	311
	Q-General experience	20.5	71.0	8.5	341
	Q-Bus driving experience	76.9	21.9	1.2	334
19	A-Accident group	30.0	20.0	50.0	60
	Q-General experience	6.3	28.1	65.6	64
	Q-Bus driving experience	45.3	42.2	12.5	64
20	A-Accident group	4.2	41.7	54.2	24
	Q-General experience	2.7	10.8	86.5	37
	Q-Bus driving experience	40.5	24.3	35.1	37
21-24	A-Accident group	5.6	13.9	80.6	36
	Q-General experience	1.2	1.2	97.6	85
	Q-Bus driving experience	42.9	14.3	42.9	84
25-54	A-Accident group	10.6	4.4	85.0	113
	Q-General experience	0.7	0.0	99.3	732
	Q-Bus driving experience	36.8	17.9	45.3	717
55 and over	A-Accident group	0.0	9.1	90.9	22
	Q-General experience	1.4	0.0	98.6	70
	Q-Bus driving experience	11.4	8.6	80.0	70
All drivers	A-Accident group	68.2	20.2	11.7	1765
	Q-General experience	40.0	15.1	44.9	2182
	Q-Bus driving experience	66.5	12.8	20.7	2143

Table 41. Other driver age in accidents with school bus drivers.

Other Driver Age	Number	Relative Frequency Percent	Adjusted Frequency Percent	
Under driving age	4	0.2	0.3	
16	93	5.8	7.5	14.7
17	86	5.4	6.9	
18	51	3.2	6.1	7.6
19	44	2.7	3.5	
20	40	2.5	3.2	18.1
21-24	185	11.5	14.9	
25-54	600	37.4	48.3	
55 and over	138	8.6	11.1	
Not stated	362	22.6		
Total	1603	100	100	

Table 42. Occupations of the school bus drivers over 20 in the questionnaire sample (column percentage in parentheses).

Occupation	21-24		25-54		55+		All Adults	
	N	(%)	N	(%)	N	(%)	N	(%)
Professional	2	(2.5)	24	(3.4)	2	(3.1)	28	(3.3)
Clerical	3	(3.7)	44	(6.3)	1	(1.6)	48	(5.7)
Skilled	6	(7.4)	41	(5.8)	1	(1.6)	48	(5.7)
Unskilled	7	(8.6)	25	(3.6)	1	(1.6)	33	(3.9)
Farm work	4	(4.9)	39	(5.6)	14	(21.9)	57	(6.7)
College	8	(9.9)	2	(0.3)	0	(0)	10	(1.2)
Home	15	(18.5)	244	(34.8)	7	(10.9)	266	(31.4)
Retired or unemployed	0	(0)	4	(0.6)	16	(25.0)	20	(2.4)
School employee	36	(44.4)	278	(39.7)	22	(34.4)	336	(39.7)
Total	81		701		64		846	

Table 43. Occupations of the younger drivers not attending school in the questionnaire sample (column percentage in parentheses).

Occupation	Age In Years 17	18	19	20	All Young Drivers
Clerical	1	0	2	2	5 (5.8)
Skilled	1	0	2	3	6 (7.0)
Unskilled	1	4	3	3	11 (12.8)
Farm	0	2	1	0	3 (3.5)
Home or unemployed	0	2	5	2	9 (10.4)
College	0	6	11	10	27 (31.4)
School employee	1	4	5	9	19 (22.1)
Not stated	1	2	2	1	6 (7.0)
Total	5	20	31	30	86 (100)

Table 44. Grades of student school bus drivers in the questionnaire sample (column percentage in parentheses).

Grades	Age in Years 16		17		18		19		20		All Student Drivers
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	
A	12	(4.9)	41	(6.8)	17	(5.4)	0	(0)	0	(0)	70 (5.8)
B	99	(40.6)	243	(40.4)	130	(41.7)	10	(30.3)	1	(14.3)	483 (40.4)
C	129	(52.9)	299	(49.8)	150	(48.1)	23	(69.7)	6	(85.7)	607 (50.7)
D	4	(1.6)	18	(3.0)	15	(4.8)	0	(0)	0	(0)	37 (3.1)
Total	244		601		312		33		7		1197

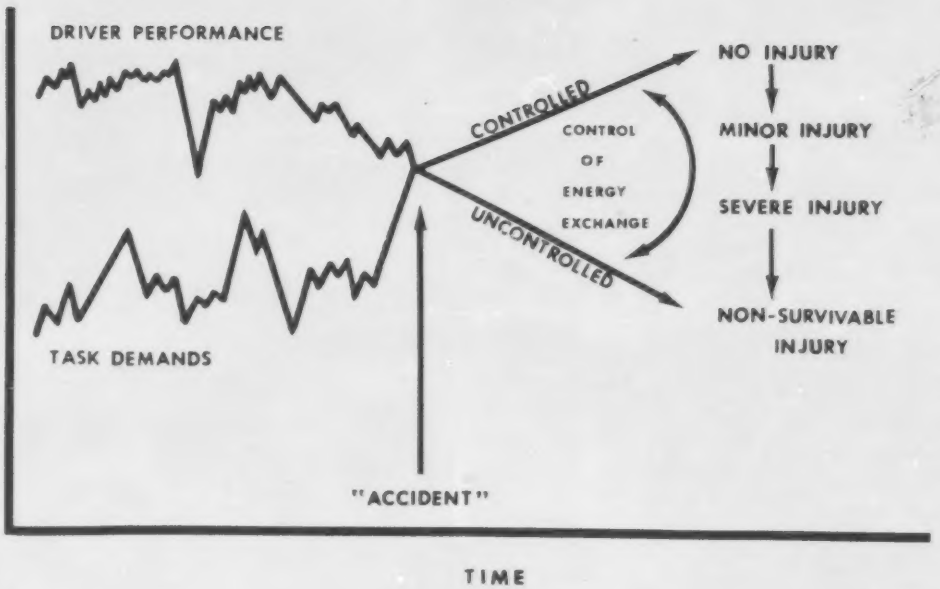

Figure 1. An "accident" model.
(from J.A. Waller, 1967)

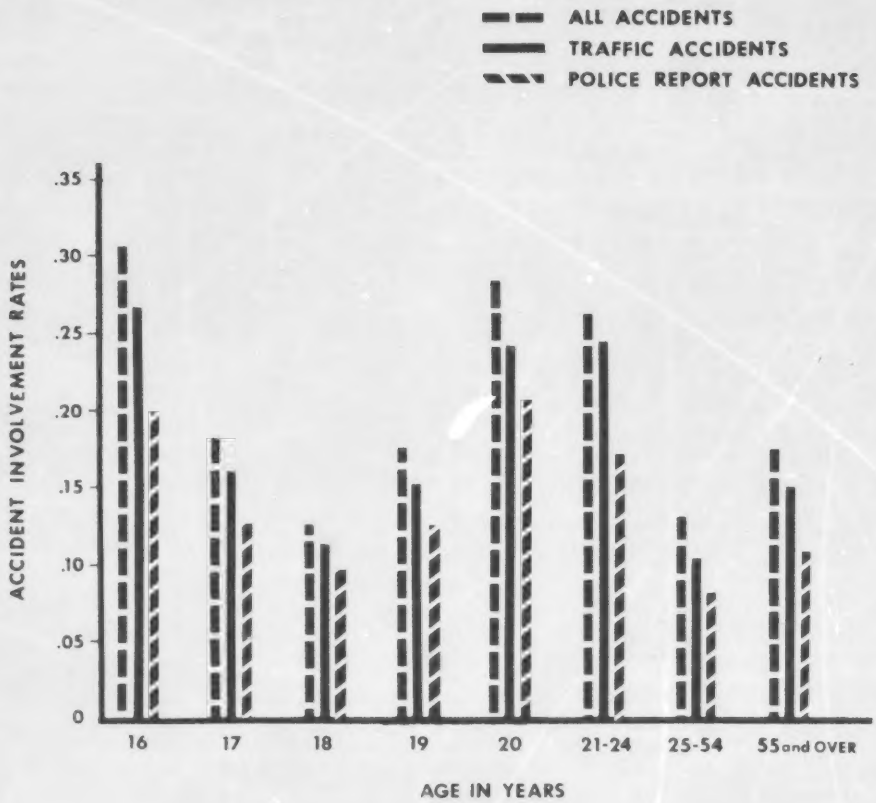

Figure 2. Accident involvement rates by driver age groups (percentage of each group involved in accidents).

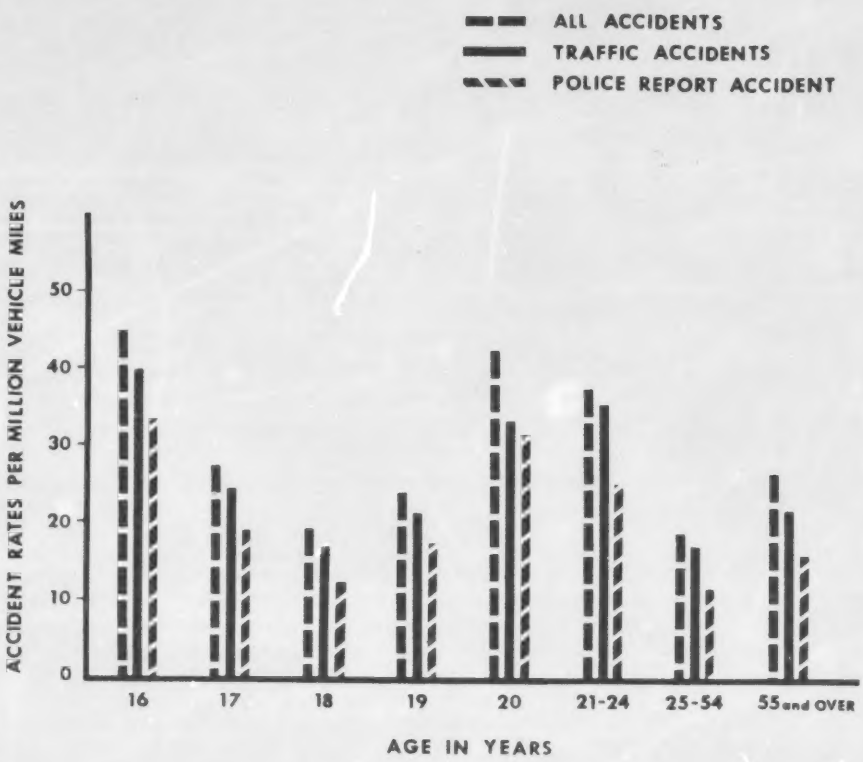

Figure 3. Accident rates per million vehicle miles for types of accident reports by driver age groups.

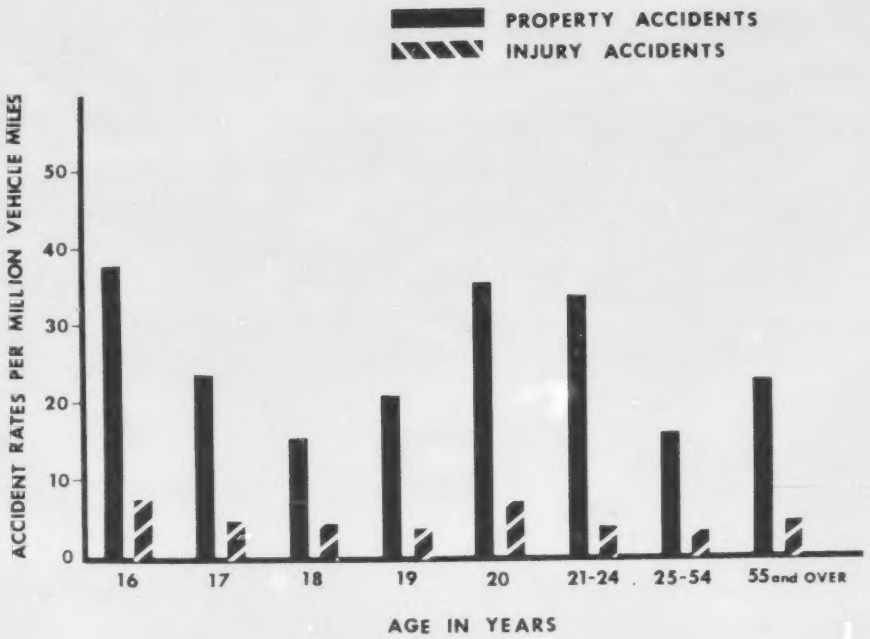

Figure 4. Accident rates per million vehicle miles for injury and property damage only accidents by driver age groups.

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APPENDIX A

Traffic Accident Report

TRAFFIC ACCIDENT REPORT

N. C. Department of Motor Vehicles DMV-349 (Rev. 4-1-65)

ADDED BY ____ (Initial)

MARKS

DATE: Date of Accident ____ 19 ____ Day of Week ____ Hour ____ A.M. ☐ P.M. ☐

LOCATION: Accident occurred: In City ____ County, or town of ____ Outside City or Town ____ Miles ☐ N ☐ E ☐ S ☐ W of ____ (City or Town) ☐ Limits ☐ Center

On ____ (Hwy. No. if U.S., N.C., R.P., R.L.) at its intersection with ____ (Street or Hwy. no.)

If not at intersection ____ ☐ Miles ☐ Feet ☐ N ☐ E ☐ S ☐ W from ____ (Highway No., or Adjacent County Line) toward ____ (Highway No., City, or Adjacent County Line)

ACCIDENT TYPE: 1. Ran off Road: 1 Right, 2 Left | Road Collision on Road: 3 Overturned, 4 Other in road | 5. Pedestrian | 6. Other Motor Vehicle | Collision of Motor Vehicle in Road With: Parked Vehicle | 8. Train | 9. Bicycle | 10. Animal | 11. Fixed Object | 12. Other Object

No. of Vehicles Involved ____

Driver ____ First ____ Middle ____ Last Name ____ Street or RFD ____ City and State ____ Date of Birth ____ Month, Date, Year

Age ____ Sex ____ Race ____ Driving Experience ____ Years ____ Driver's License ____ Number ____ State ____ Oper. ☐ Chauff. ☐ Specify Restriction ____ Member of Armed Forces: Yes ☐ No ☐

VEHICLE NO. 1: Veh. Year ____ Make ____ Color ____ Registration ____ Number ____ State ____ Year ____ M.V. No. ____

Amount of Damage: Owned By ____ Drivable ____ Name ____ Street or RFD ____ City and State ____ Parts Damaged ____

Yes ☐ No ☐ Vehicle Removed To ____ By ____ $ ____

VEHICLE NO. 2 OR PEDESTRIAN: Driver or Pedestrian ____ First ____ Middle ____ Last Name ____ Street or RFD ____ City and State ____ Date of Birth ____ Month, Date, Year

Age ____ Sex ____ Race ____ Driving Experience ____ Years ____ Driver's License ____ Number ____ State ____ Oper. ☐ Chauff. ☐ Specify Restriction ____ Member of Armed Forces: Yes ☐ No ☐

Veh. Year ____ Make ____ Color ____ Registration ____ Number ____ State ____ Year ____ M.V. No. ____

Amount of Damage: Owned By ____ Drivable ____ Name ____ Street or RFD ____ City and State ____ Parts Damaged ____

Yes ☐ No ☐ Vehicle Removed To ____ By ____ $ ____

Amt. of Dam. Other Property Damage $ ____ Owner and Address ____

Injury Class: K. Killed | A. Visible sign of injury as bleeding, wound, distorted member, or must be carried from scene | B. Other visible injury or bruises, abrasions, swelling, limping, etc. | C. No visible sign of injury but complaint of pain or momentary unconsciousness

INJURED PERSONS (Include fatally injured)	Veh.	Age	Sex	Race	Injury Cl.	Name	Street or RFD	City	State

INDICATE NORTH

Injured taken to ____

Describe what happened ____

Tire impressions prior to impact: No. 1 ____ No. 2 ____

Distance of travel after impact: No. 1 ____ No. 2 ____

WITNESSES: Name ____ Address ____

Name ____ Address ____

Arrests: Name ____ Charge(s) ____ (Cit. No.) ____

Name ____ Charge(s) ____ (Cit. No.) ____

Sign Here ____ (Officer's rank and name) ____ Number ____ Department ____ Date of report ____

City, Case No.

Authority for removal of vehicles

Veh. 1

Veh. 2

Zone No.

Tract No.

If city vehicle is prop. dam. give name of authority involved.

Veh. 1

Veh. 2

Remarks

VEHICLE 1

POINT OF INITIAL CONTACT

VEHICLE 2

POINT OF INITIAL CONTACT

DIRECTION OF TRAVEL

VEH. 1 N E S W ON

VEH. 2 OR PED N E S W ON

POLICE ACTIVITY

Time Notified of Accident (Date) (Hour) ☐ a.m. ☐ p.m.

Time Arrived at Scene (Hour) ☐ a.m. ☐ p.m.

Source of information (Officer at scene, driver, witness, station, etc.)

ROADWAY FEATURE (Check if applicable)

1. Bridge or Underpass
2. Curve
3. ☐ Intersection
4. ☐ Intersection of Two Roadways
5. ☐ Intersection Related
6. ☐ Driveway, Alley Access or Entrance
7. ☐ Parking Lot

LOCALITY (Check one)

1. Business
2. Residence
3. ☐ Playground
4. ☐ School

HEAD ON OBJECT STRUCK (Check one or more)

1. Tree
2. Pole
3. Fence (Type)
4. Guard Rail or Guard Post
5. Curb or Island
6. Bridge
7. Embankment
8. Traffic Control Device (Type)
9. Sign or Sign Post
10. Other Object
11. No Object Involved

ROAD CHARACTER (Check one)

1. Straight and Level
2. Straight and Grade
3. Straight and Hillcrest
4. Curve and Level
5. Curve and Grade
6. Curve and Hillcrest
7. Curve and Grade
8. Other Curve
9. Other Grade

ROAD CONDITION (Check one)

1. Dry
2. Wet
3. ☐
4. Muddy
5. Icy
6. ☐

TRAFFIC CONTROL (Check one or more)

1. Stop Sign
2. Yield Sign
3. Stop and Go Signal
4. Flashing Signal with Stop Sign
5. Flashing Signal without Stop Sign
6. R.R. Gate and Flagman
7. R.R. Flasher
8. Officer
9. Other Device
10. No Control Present
11. Control not operating properly
12. Control not visible or legible

ROAD DEFECTS (Check one)

1. Loose material on surface
2. Holes, deep ruts
3. Low shoulders
4. Soft shoulders
5. Other defects
6. Road under construction
7. No defects

CONSTRUCTION (Check one)

1. Concrete
2. Oiled or Asphalt
3. Gravel or Asphalt
4. Gravel
5. Dirt or Sand
6. Other (Specify)

LIGHT CONDITION (Check one)

1. Daylight
2. Dusk
3. Dawn
4. Darkness (street lighted)
5. Darkness (street not lighted)

WEATHER (Check one)

1. Clear
2. Cloudy
3. Raining
4. Snowing
5. Fog
6. Dust or Mist

VEHICLE TYPE

Vehicle 1 2

1. Car
2. House Trailer
3. Trailer
4. Truck
5. Truck 2 axles
6. Truck 3 axles
7. Truck Tractor and Semi-Trailer
8. Truck and Trailer
9. Bus
10. Other (Specify)
11. Emergency Vehicle

VEHICLE CONDITION (Vehicle 1 2) (Check one or more)

1. Defective Brakes
2. Defective Headlights
3. Defective Rear Lights
4. Defective Steering
5. Defective Tires
6. Other defect or equipment (Specify)
7. Not Applicable
8. No defects indicated

VISION OBSTRUCTION (Check one)

Driver 1 2

1. Windshield or windows
2. Buildings, trees, bushes, etc.
3. No vision obstruction

Posted speed limit mph

Speed of vehicle mph

Speed of vehicle 2 mph

CAUSES OF ACCIDENT

(Check one or more for each driver)

Driver 1 2

1. Exceeding posted limit
2. Failed to yield right of way
3. Drove left of center
4. Improper overtaking
5. Passed stop sign
6. Disregarded traffic signal
7. Followed too closely
8. Made improper turn
9. Improper traffic signal
10. Improper parking position
11. Other improper driving (Specify)
12. No violation indicated

WHAT DRIVERS WERE DOING BEFORE ACCIDENT

Driver 1 2

(NON-MOVING Vehicles)

10. Stopped in Travel Lane
11. Parked out of travel lanes
12. Parked in travel lanes

(MOVING Vehicles)

1. Going straight ahead
2. Changing Lanes or Merging
3. Passing
4. Making right turn
5. Making left turn
6. Making U turn
7. Backing
8. Slowing or Stopping
9. Starting in Roadway
10. Parking
11. Leaving Parked Position
12. All Other

WHAT PEDESTRIAN WAS DOING (Check one)

1. Crossing at intersection
2. Crossing not at intersection
3. Coming from behind parked vehicle
4. Walking in roadway with traffic
5. Walking in roadway against traffic
6. Getting on or off vehicle
7. Standing in roadway
8. Working in roadway
9. Playing in roadway
10. Lying in roadway
11. Other in roadway (Specify)
12. Not in roadway

APPARENT PHYSICAL CONDITION (Other than sobriety)

Driver 1 2 or PED

1. ☐
2. Fatigued
3. Asleep
4. Other Physical Impairment
5. Restriction not Complied with
6. Normal
7. Condition not known

APPARENT SOBRIETY

0. Had not been drinking
1. Drinking—Ability Impaired
2. Drinking—Unable to determine Impairment
3. Chemical test given

71

83

APPENDIX B

School Bus Accident Report

Form TD 25

SCHOOL BUS ACCIDENT REPORT

PLEASE ANSWER EVERY QUESTION FULLY

(Every school bus accident which involves an injury, or death, or property damage must be reported promptly on this form. Two copies to be sent to State Board of Education. One copy to be retained by County Superintendent.)

SCHOOL _____ COUNTY _____

Location: Accident occurred on:

Time: Day _____ Date _____ 19 _____ Time _____ A.M. _____ P.M.

Bus Driver: Name of driver _____ Telephone No. _____

Address _____

Age _____ yrs. Sex _____ Race _____ Experience _____ yrs. Student _____ Adult _____

School Bus: (Vehicle # 1) Bus No. _____ License No. _____ Make _____ Model _____

No. pupils on bus at time of accident _____ Estimated speed at time of accident _____ M. P. H.

Damage to bus _____

Was bus driver injured? _____ Estimated Cost for Repairs $ _____

Injuries:

Names of Injured Persons	Age	*Identification	Nature of Injuries	Attending Physician

* Identify as either: bus driver; transported pupil; walking pupil; other pedestrian; transported school employee.

Other vehicle: (Vehicle # 2) Name of driver _____ Age _____ Address _____

Type vehicle _____ Year Model _____ License No. _____ Speed at time of accident _____ M.P.H.

Damage to vehicle $ _____ Owner of vehicle _____

Address _____ Tel. No. _____

**Names of injured and extent of injuries _____

Accident Involved: ☐ Pedestrian ☐ Other motor vehicle ☐ R. R. train ☐ Animal-drawn vehicle ☐ Bicycle ☐ Fixed object ☐ Animal (ridden, herded, unattended) ☐ Overturned in roadway ☐ Ran off roadway ☐ Other non-collision (fell from vehicle, fire, etc.) ☐ Other (explain in remarks)

(TO BE DESCRIBED BY SCHOOL OFFICIAL INVESTIGATING THE ACCIDENT)

***Description: (Give full description of conditions leading to accident, what each driver did, details determining responsibility etc.)

_____ Signature of School Official Investigator

Statement of Driver of School Bus: (Vehicle # 1)

_____ Signature of Driver of School Bus

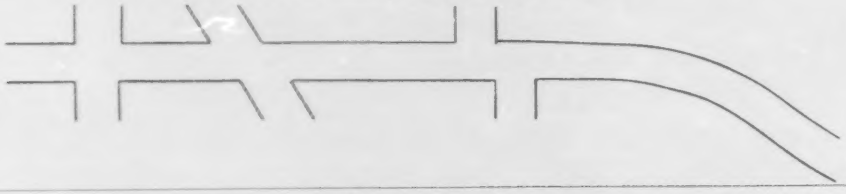
**If vehicle # 2 is a public school bus, list same information as for # 1.

***To be filled in by investigator.

(OVER)

Fill out. Show how accident occurred by using this diagram

Diagram of accident



WITNESSES

Name Address

Name Address

PEDESTRIAN: Was going ☐ On ☐ Across Street name, Highway No. From (S. E. corner or west side to N. E. corner, or east side, etc.) To

Check one: Direction Nationality or race Occupation

Was pedestrian violating traffic law? ☐ Yes ☐ No

WHAT PEDESTRIAN WAS DOING

1 Crossing at intersection with signal
2 Same against signal
3 Same with signal
4 Same—diagonally
5 Crossing not at intersection
6 Coming from behind parked cars
7 Walking in roadway (which way)
a. With traffic ☐ b. Sidewalks available
c. Against traffic ☐ d. Path available
8 Standing in safety zone
9 Getting on or off other vehicle
10 Working in roadway
11 Playing in roadway
12 Working on vehicle
13 Lying in roadway
14 Not in roadway except at edge (which)

WHAT DRIVERS WERE DOING

Vehicle 1 2 — Check one for each driver

1 Making right turn
2 Making left turn
3 Making U-turn
4 Going straight ahead
5 Backing
6 Slowing or stopping
7 Starting from traffic lane
8 Starting from parked position
9 Passing in traffic lane
10 Parked
11 Backing
Check applicable items:
12 Overtaking
13 Avoiding car, object or person
14 Speeding

VIOLATIONS INDICATED (Check one or more for each vehicle)

Vehicle 1 2

1 Failed to yield right of way
2 Improper backing
3 Made improper turn
4 Following too closely
5 Improper passing
6 Driving on wrong side of road
7 Speed too great for conditions
8 Improper parking
9 Inattentive driving
10 Reckless driving
11 Hit and run
12 Driver's license suspended/revoked
13 Failed to see if movement could be made in safety
14 Failed to stop in an emergency
15 Allowed unlicensed person to operate vehicle
16 Failed to signal
17 Improper signal
18 Improper or defective equip.
19 Drove through safety zone
20 Stop sign violation
21 Violated warning sign, night
22 Passed stopped school bus
23 Passenger(s) distracted bus drivers attention
24 Failed to take proper precaution in leaving bus
25 Improper start from parked position
26 No violation indicated
27 Other improper action (explain)

CONDITION OF DRIVER(S) 1 AND PEDESTRIAN (Check one or more)

1 Ped 2 Ped

Physical defect, eyesight etc.
Other handicap
Fatigued
Apparently asleep
Apparently normal
Had been drinking
Had been drinking, if so
Observed's guess
Agency inspected
Apparently normal
Not known whether inspected

TRAFFIC CONTROL (Check one)

1 R. R. crossing gates
2 R. R. crossing (automatic) signal
3 Officer or watchman
4 Stop (sign) light
5 Stop sign in front
6 Warning sign or signal
7
8
9 Not traffic controlled
Specify other

WEATHER (Check one)

1 Clear
2 Cloudy
3 Raining
4 Snowing
5 Fog
6
Specify other

LIGHT (Check one)

1 Daylight
2 Dusk
3 Dawn
4 Dark
Street lights on
5 Street lights on (if lighted, specify)
6 Dark—no lights
Dark—lights not lighted

VEHICLE DEFECTS (Check one or more)

Vehicle 1 2

Defective brakes
Lighting equipment
Steering mechanism
Tires
Other defects
No defects
Not known
Explain fully in remarks

VISION OBSCURED (Check where applicable)

Vehicle 1 2

1 Rain, snow, etc. on windshield
2 Windshield otherwise obscured
3 Vision obscured by load on vehicle

HIGHWAY

Vehicle 1 2

1 Trees, crops, etc.
2 Building
3 Embankment
4 Signboards
5 Hillcrest
6 Parked cars
7 Moving cars

TYPE OF LOCALITY

Check one in vicinity (not the exact spot) within 100 feet are primarily:

1 Residential
2 Institutional and industrial
3 Business and business and residential
4 Residential district
5 Open country
6
Specify other

SUMMARY CHARACTER

Vehicle 1 2

1 Both vehicles moving
2 Straight ahead
3 Other moving
4 Parked
5 Other stopped

Check one for each car:

Not stopped
1 On grade
2 At crest
3 At sag
4 Other grade

ROAD SURFACE

Check one

1 Concrete
2 Brick
3 Asphalt
4 Gravel
5 Dirt
6 Sand
7 Mixed (gravel, dirt, sand)
8 Ice
Specify other

ROAD CONDITIONS

Check one or more

Dry
Wet
Muddy
Snowy
Icy

1 Loose material on surface
2 Holes, deep ruts
3 Defective shoulders
4 Other defects
5 No defects

Explain fully in remarks

Was road under construction or repair? ☐ Yes ☐ No

ROAD WIDTH AND LANES

Width of pavement or road surface ft

For vehicular traffic, exist. shoulders ft

Additional width of shoulders ft

Total number of traffic lanes: Were lanes marked? ☐ Yes ☐ No

Were opposing traffic lanes separated? ☐ Yes ☐ No

If so, by what

Was the highway location, width, condition in any way to blame for the accident? If so, by what?

Does this place have a bad accident record? Please state number of accidents months. How can future accidents be prevented here?

FOR SCHOOL OFFICIAL INVESTIGATOR ONLY

Show Charges Filed:

Name Charge

Name Charge

Did you witness the accident? Time notified of accident Date Time

Was investigation made at scene of accident? ☐ Yes ☐ No

Date Time ☐ A.M. ☐ P.M.

Where else was investigation made?

Is investigation complete?

SIGNATURE

Address Date of report

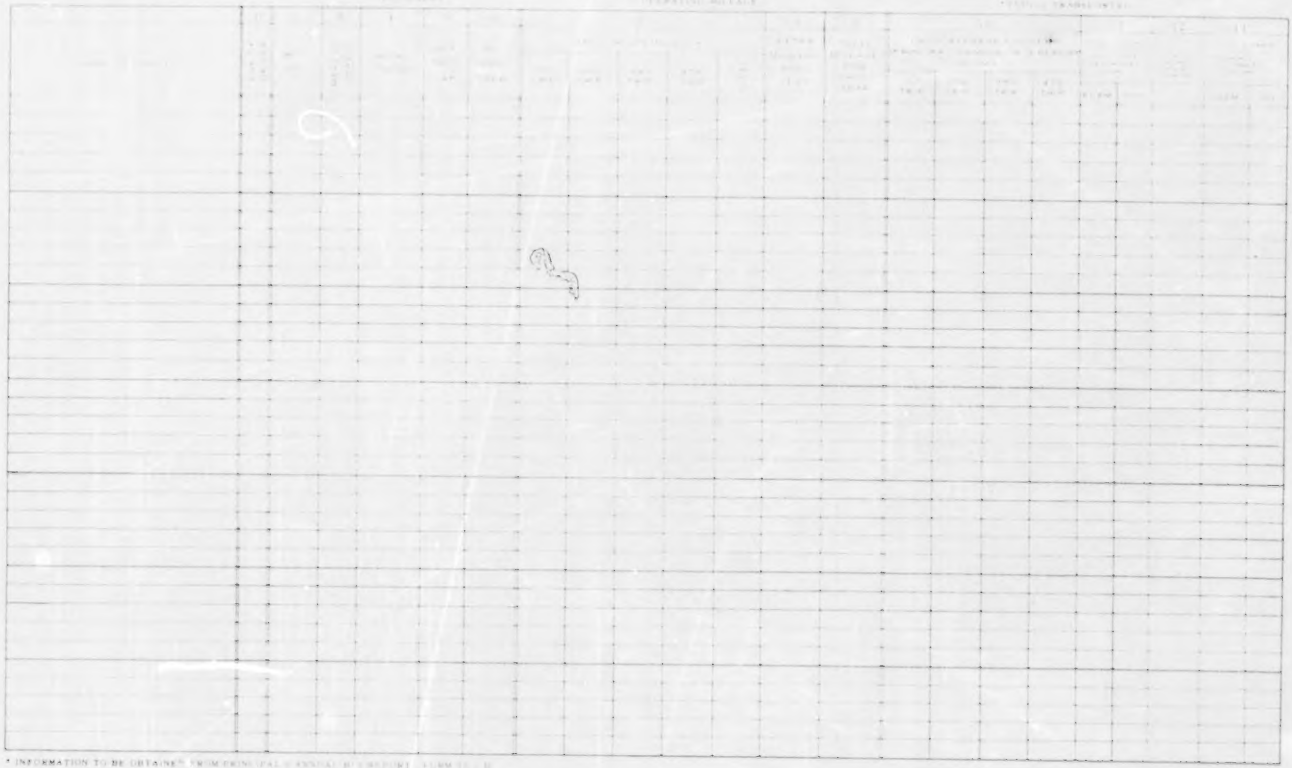
SIGNATURE

County or City Superintendent Date

APPENDIX C

Annual Pupil Transportation Report (APTR)

ANNUAL PUPIL TRANSPORTATION REPORT



* INFORMATION TO BE OBTAINED FROM PRINCIPAL'S ANNUAL REPORT - FORM TC-1 B

APPENDIX D

Questionnaire to School Bus Drivers

QUESTIONNAIRE TO SCHOOL BUS DRIVERS

(For Research Only)

PLEASE PRINT

(5) 1

(6-18) Last name (print one letter to a box)

(19-26) First name

(27) Middle initial

(28-37) Home city or town _____

(38-39) County _____

(40-45) Date of birth (in numbers) _____ _____ _____
(month) (day) (year)

(46-47) Present age (in years) _____

(48) Sex: (1) ☐ Male (2) ☐ Female

(49) Race: (1) ☐ White (2) ☐ Black, Indian, other

(50-56) What is your N.C. driver's license number? _____

(over)

(57-60) How long have you been driving? _____ (years) _____ (months)

(61-64) How long have you been driving a school bus? _____ (years) _____ (months)

(65) Besides your school bus driver certificate, what type of North Carolina driver's license do you hold? (check correct box)

(1) ☐ regular operator's license (2) ☐ chauffeur's license

(66) Are you

(1) ☐ a regular driver (2) ☐ a substitute driver

If you are a substitute bus driver, skip the next few questions and go to number (78).

(67) Is your bus driving route mainly

(1) ☐ country (2) ☐ town

About how many students do you drive daily to

(68-70) Elementary school _____

(71-73) High School _____

(74-75) What is your regular daily mileage? _____

(76-77) What is your regular daily mileage with passengers on board? (Subtract the miles you drive with an empty bus from your regular daily mileage).

_____

(78) Check the box that applies to you.

(1) ☐ Attending school

(2) ☐ Attending college or graduate school

(3) ☐ Not in school

(79-80) Circle the highest educational level that you have completed.

School 1 2 3 4 5 6 7 8 9 10 11 12 College 1 2 3 4 5 +

(5) 2

(6-13) Which school supervises the buses you drive_____

For Student Drivers Only

(14) Check your average grade in your courses last year

☐ A ☐ B ☐ C ☐ D ☐ Below D

If you are a school student, what sort of work do your parents or guardians do?

(15) Father's work _____

(16) Mother's work _____

For Adult or Non-Student Drivers Only

Check the box which best describes what you do besides driving a school bus.

(17)
(1) ☐ Professional or semi-professional
(2) ☐ Clerical or sales
(3) ☐ Skilled work
(4) ☐ Unskilled work
(5) ☐ Farm work
(6) ☐ College student
(7) ☐ Home duties
(8) ☐ Retired
(9) ☐ School employee
(0) ☐ Other. Describe _____

(18-19) If you have another paid job besides school bus driving, how many hours per week do you work on that job?_____

(20) How many paid jobs besides school bus driving have you had in the past three years?

(1) ☐ no jobs (2) ☐ one job (3) ☐ two jobs

(4) ☐ three jobs (5) ☐ four or more jobs

For Adult of Non-Student Drivers Only

If you are a school employee check the box which best describes your job.

(21) (1) ☐ Teaching staff (2) ☐ Maintenance
(3) ☐ Administrative or secretarial (4) ☐ Service
(5) ☐ Medical or welfare (6) ☐ Teaching aide
(7) ☐ Other, Describe_____

(22) What is your present marital status?
(1) ☐ Never married (2) ☐ Divorced or separated
(3) ☐ Married (4) ☐ Widowed

(23) How many children do you have?
(1) ☐ One (2) ☐ Two (3) ☐ Three
(4) ☐ Four (5) ☐ Five or more (6) ☐ None

If you have children, how many are

(24-25) Too young yet for school _____

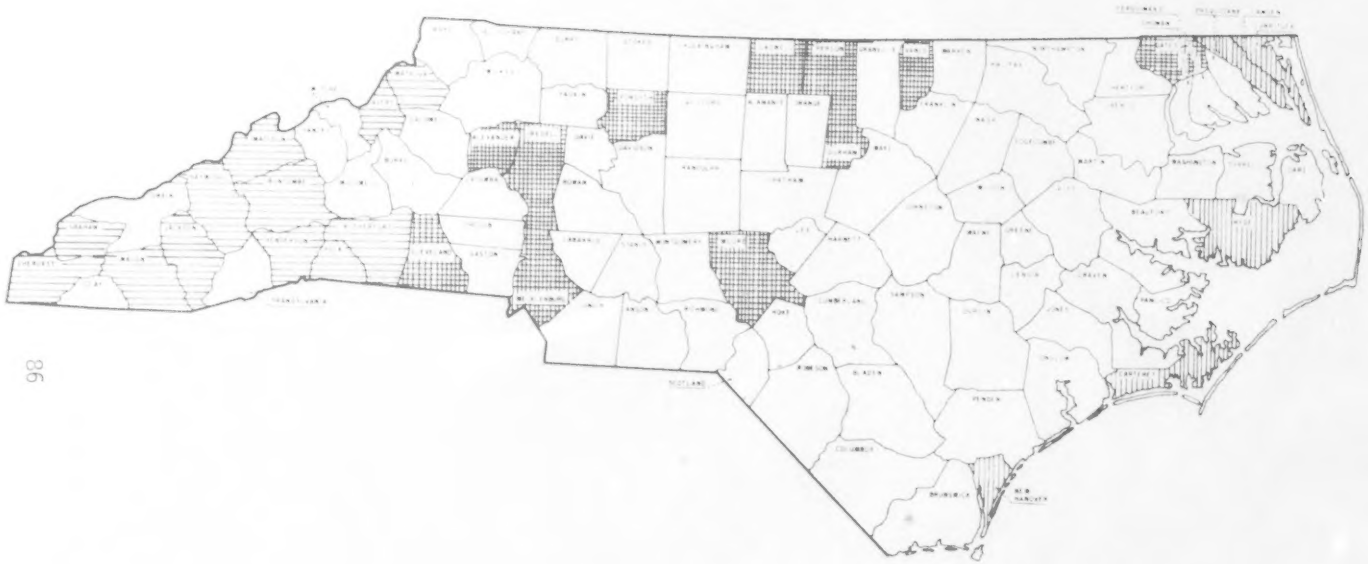
(26-27) Attending school _____

(28-29) In college _____

(30-31) Have finished school _____

APPENDIX E

Map of Counties in Questionnaire Sample



mountain

piedmont

coastal

APPENDIX F

Number of Accidents and Total Number of Drivers
in Each Age Group

Appendix F. Number of Accidents and Total Number of Drivers in Each Age Group

Age Group	Number of Drivers	All Accidents	Police Reports	Traffic Accidents	Property Accidents	Injury Accidents
16 years	1494	455	306	404	382	73
17	4484	816	575	726	693	123
18	2603	334	251	300	265	69
19	391	67	48	60	57	10
20	91	26	19	21	22	4
21-24	145	38	25	36	34	4
25-54	962	126	81	114	108	18
55+	146	26	16	22	22	4
Total	10316	1888	1321	1683	1583	305
Students	9063	1698	1199	1511	1419	279
Adults	1340	190	122	172	164	26
Total	10403	1888	1321	1683	1583	305
Unknown	105	83				

APPENDIX G

Statistical Explanation of Chi-Square Used
(Written by Dr. Yoseph Hochberg)

Let X_{ijk} be the number of accidents of a specified type performed by the jth driver in the ith group on driving his kth 10^6 miles, where $k = 1,\ldots, K_{ij}$, $j = 1,\ldots, J_i$, and $i = 1,2$. Put $X_{ij} = \sum_{k=1}^{K_{ij}} X_{ijk}$. We assume that X_{ijk} is a Poisson random variable with intensity $\lambda_{ij} = \lambda_i + v_{ij}$, where $\sum_{j=1}^{J_i} v_{ij} = 0$, $i = 1,2$. If the sets of bivariate observations $\{X_{ij}, K_{ij}\}$ were available and could be regarded as simple random samples from we well defined reference populations in which λ_i is the average intensity in the ith population group, then to compare average population intensities between two groups one would use the statistic

$$\left(\sum_{j=1}^{J_1}\frac{\left(\frac{X_{1j}}{K_{1j}}\right)}{J_1} - \sum_{j=1}^{J_2}\frac{\left(\frac{X_{2j}}{K_{2j}}\right)}{J_2}\right)^2 \Bigg/ \left[\frac{1}{J_1^2}\sum_{j=1}^{J_1}\frac{X_{1j}}{K_{1j}^2} + \frac{1}{J_2^2}\sum_{j=1}^{J_2}\frac{X_{2j}}{K_{2j}^2}\right]$$

which conditionally on the K_{ij} is approximately distributed as a Chi-square with 1 d.f.

In this case the bivariate observations $\{X_{ij}, K_{ij}\}$ are not available but rather, we have the unmatched pieces $\{X_{ij}\}$ and $\{K_{ij}\}$. In this case, however, it seems that rather than testing H: $\lambda_1 = \lambda_2$ the problem of main importance is to test whether the means of the $T_i = \sum_{j=1}^{J_i} X_{ij} \Big/ \sum_{j=1}^{J_i} K_{ij}$, $i = 1,2$ are the same. Conditional on the K_{ij}'s, the statistics T_i are approximately normal with variance

$$\mathrm{Var}(T_i) = \frac{\lambda_i}{\sum_{j=1}^{J_i} K_{ij}} + \frac{\sum_{j=1}^{J_i} K_{ij}\, v_{ij}}{\left(\sum_{j=1}^{J_i} K_{ij}\right)^2}$$

an appropriate statistic for our case is thus of the form

$S = (T_1 - T_2)^2 \Big/ s^2(T_1 - T_2)$

where $s^2(T_1 - T_2)$ is an estimate of variance $(T_1 - T_2)$. In this case

$$s^2(T_1 - T_2) = \frac{T_1}{\sum_{j=1}^{J_1} K_{1j}} + \frac{T_2}{\sum_{j=1}^{J_2} K_{2j}}$$

The resulting statistic S is approximately distributed as a Chi-square with 1 d.f. Such test statistics were used to assess differences in accident intensities between the various pairs of groups in this work.

Annual mileage and number of accidents per age group.

Age	Number of "All Accidents"	Total Yearly Mileage	Chi-Square	p
16	455	10,068,037	121.00	< .005
17	816	29,950,399	.08	N.S.[1]
18	334	17,394,984	56.92	< .005
19	67	2,767,856	3.25	N.S.
20	26	617,924	3.66	N.S.
21-24	38	1,014,464	3.15	N.S.
25-54	126	6,776,624	34.16	< .005
55 and over	26	990,682	.05	N.S.
	1888	69,580,960		
16-20	1698	60,799,200	13.52	.005
21 and over	190	8,781,770		
17-20	1243	50,731,163	2.78	N.S.
21 and over	190	8,781,770		

[1]Not Significant

APPENDIX I'

Number of Fatalities and Injuries
in Each Accident Bus Driver Age Group

Appendix H. Number of fatalities and injuries in each accident bus driver age group.

Driver Age	Driver Injured	Bus Passenger Killed	Passengers Injured A	B	C	Pedestrian Killed or Injured	Total
16	5	1	31	42	37	3	119
17	12	1	22	62	80	9	186
18	1	1	15	36	35	1	89
19	1	0	1	1	7	0	10
20	0	1	0	0	8	0	9
21-24	0	0	0	0	8	0	8
25-54	4	0	19	15	5	0	43
55+	1	0	2	0	4	1	8
Total	24	4	90	156	184	14	472